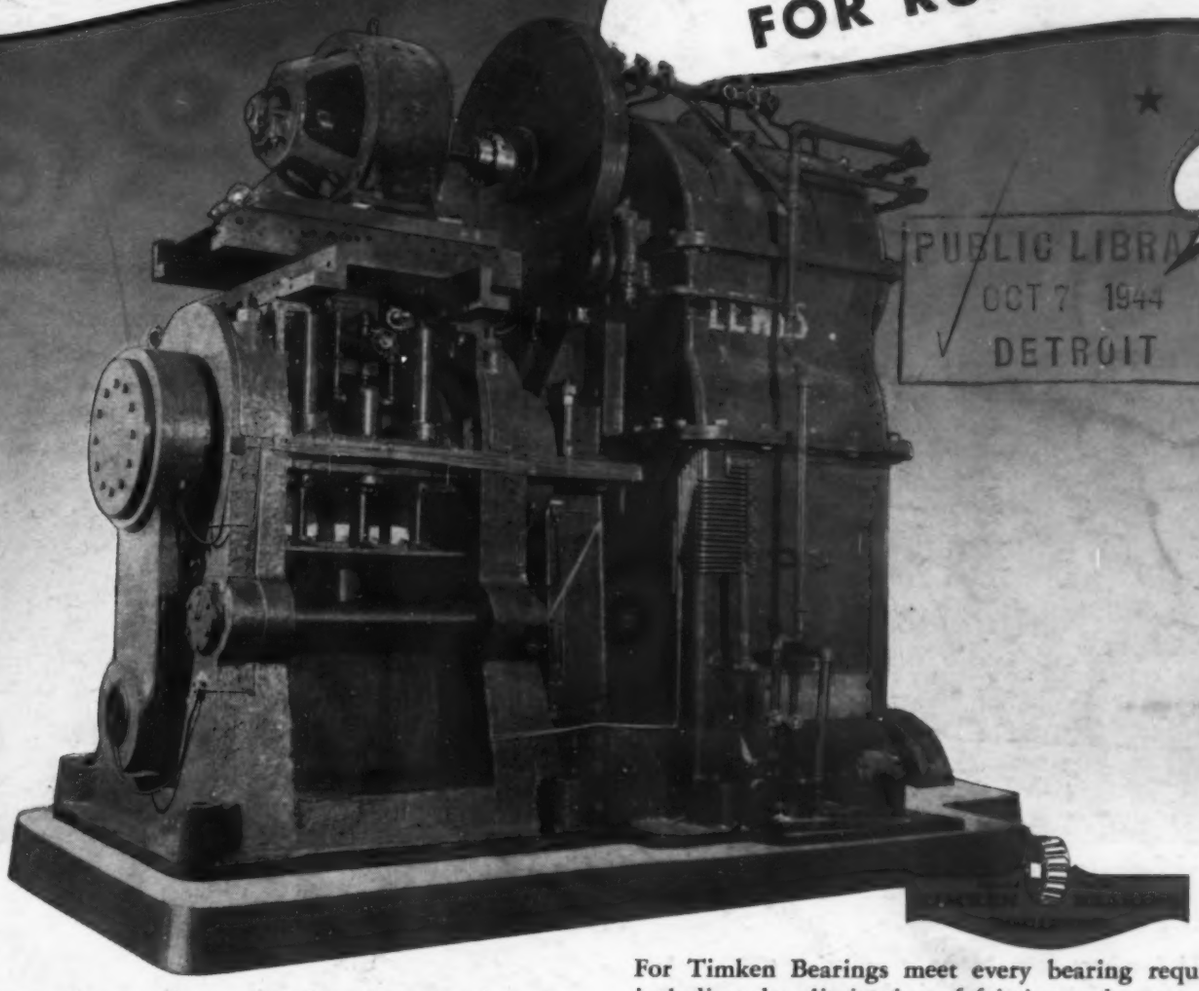
Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

1010 EMPIRE BUILDING — September 1944 — PITTSBURGH, PA.

TECHNOLOGY DEPT.

TIMKEN BEARING EQUIPPED UPCUT SHEARS FOR RUSSIA



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OCT 7 1944
DETROIT

The upcut shears shown in the photograph were manufactured by Lewis Foundry & Machine Company and shipped to Russia recently under lend lease.

They will handle 6" x 6" bars hot, or 5" x 5" bars cold. Timken Tapered Roller Bearings are used on the motor pinion shaft, first intermediate shaft and second intermediate shaft.

By selecting Timken Bearings for these vital positions, the manufacturer has added considerably to the operating efficiency; dependability; and endurance of the shears, besides cutting maintenance time and cost.

For Timken Bearings meet every bearing requirement including the elimination of friction and wear; the safe carrying of radial, thrust and combined loads; and the holding of moving parts in correct and constant alignment.

Hundreds of thousands of Timken Bearings are in service in American equipment in Russia — from precision machine tools to huge steel rolling mills. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

PERFORMANCE *Proves it*

. . . Still the LEADING Mill Duty Brake

The passing years have served only to prove how RIGHT the basic design of the Cutler-Hammer Magnetic Brake was in the first place. True, improvements and refinements have been made as advancing technology has revealed new and better materials . . . and by the engineering that has made Cutler-Hammer world-famous. But time, performance and preference show it still to be unequalled. In simplicity, in direct action, in efficiency, in ruggedness, dependability, and accessibility, the C-H Type M Brake remains what it was when it first was announced . . . the standard of performance wherever D.C. Mill Duty Brakes are used. *Compare.* There can be only one conclusion.

THE P-100 CRANE SAFETY LIMIT STOP

that set New Standards of Safety

It has been said that no crane safety limit stop has so completely embodied what steel mill engineers want as the Cutler-Hammer P-100 . . . good companion for the C-H Type M Brake. Unfailing operation, durability, simple design and complete accessibility are only the highlights in this crane safety limit stop with fifteen outstanding construction and operation features that bring conviction as you study them. For crane safety get all the facts. CUTLER-HAMMER, Inc., 1269 St. Paul Ave., Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ont.

CUTLER-HAMMER
MOTOR CONTROL
C-H

Trimming 90 min. to 30 min. per piece

To cut a ½" Acme thread in a part for the 155 mm gun required an hour and a half on a lathe . . . too long to maintain a high production rate. An Aetna-Standard engineer designed the special gadget you see in the photograph. He hooked it on to a standard milling machine. Now we turn out one part every 30 minutes instead of 90 minutes.

Aetna-Standard Can Help You Shorten Your Reconversion Period

Aetna-Standard has no magic wand to make conversion problems disappear but we do have some practical suggestions which may speed your planning.

1. Aetna-Standard's engineers can rearrange your plant or assist your own plant men to provide most efficient peacetime production. When necessary, they can build an entire new plant, including the buildings, or remodel an old plant.

2. Aetna-Standard can design and build any type of machine or equipment which you may need for your future requirements.

3. During your retooling period you may want Aetna-Standard to handle some of your production in its own plants on a sub-contract basis.

One of the first manufacturers to convert to war production, Aetna-Standard plants continue to hum every minute of every day on the production of general machinery and war materiel, such as 37 and 90 mm A.A. guns, 105 mm Howitzer Carriages, Field Guns, and many other ordnance items.

In your planning, consider Aetna-Standard

THE AETNA•STANDARD
ENGINEERING COMPANY
YOUNGSTOWN, OHIO

DESIGNERS AND BUILDERS to the Steel, Non-Ferrous and Chemical Industries.

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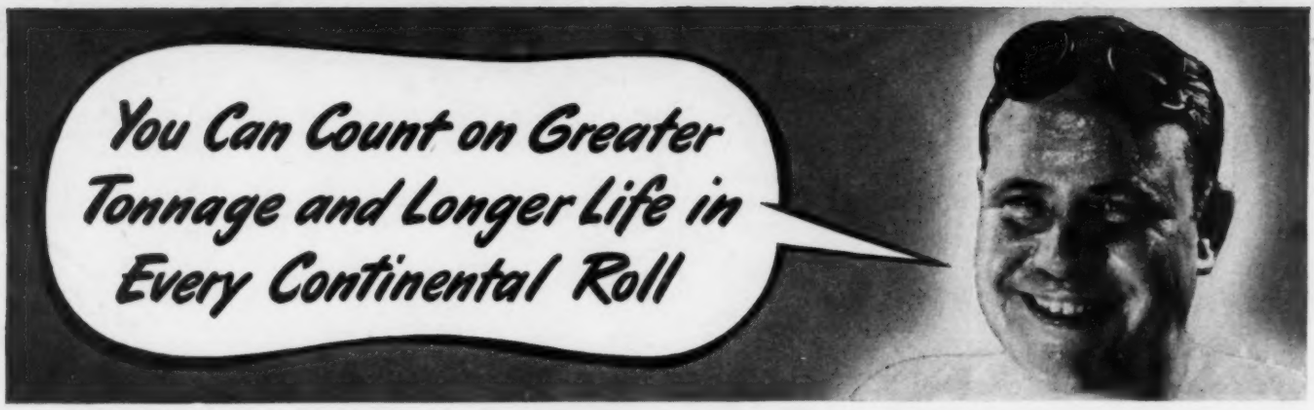
JOHN INGLIS COMPANY, LIMITED, TORONTO, ONTARIO, CANADA



Continental Back Up Rolls

Quality is a by-word with Continental craftsmen for theirs is a job of making the finest rolls for high speed mill operation.

This unusual skill, advanced engineering and modern equipment are your assurance of highest quality for all types of rolls.

Other products which Continental manufactures include Rolling Mill Equipment, Special Machinery and Carbon and Alloy Steel Castings. Continental Foundry & Machine Company.

CONTINENTAL FOUNDRY & MACHINE COMPANY

(FORMERLY CONTINENTAL ROLL & STEEL FOUNDRY COMPANY)

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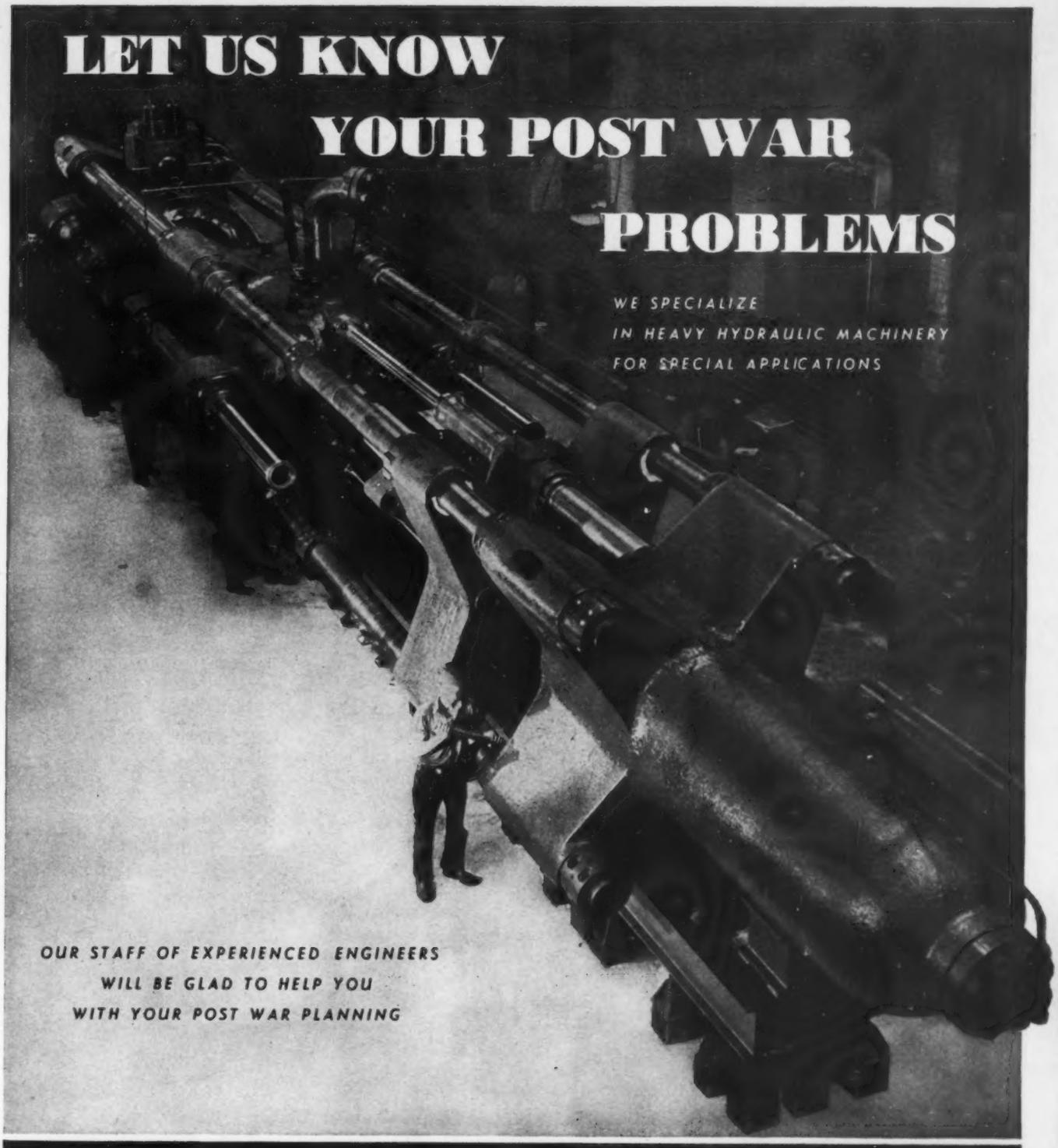
LET US KNOW YOUR POST WAR PROBLEMS

WE SPECIALIZE
IN HEAVY HYDRAULIC MACHINERY
FOR SPECIAL APPLICATIONS



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WILL BE GLAD TO HELP YOU
WITH YOUR POST WAR PLANNING

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STRETCHERS · PUMPS · ACCUMULATORS

570 LEXINGTON AVENUE · NEW YORK · N. Y.

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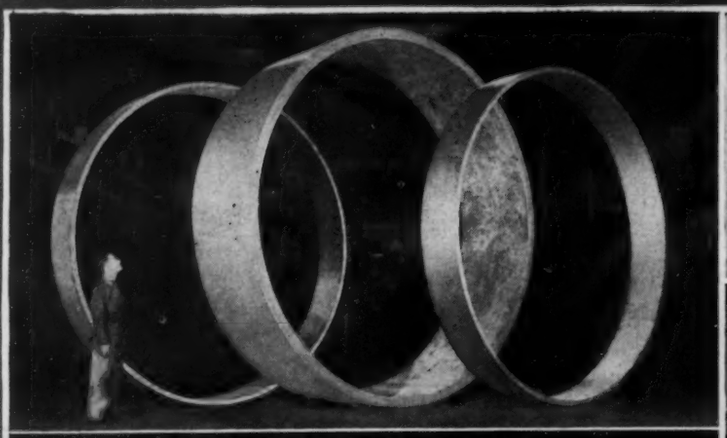
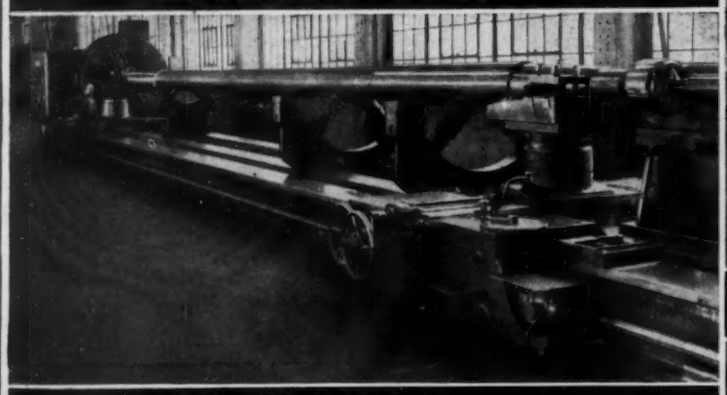
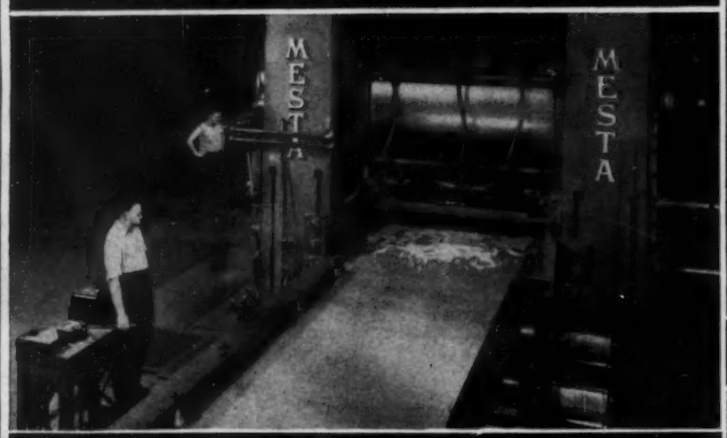


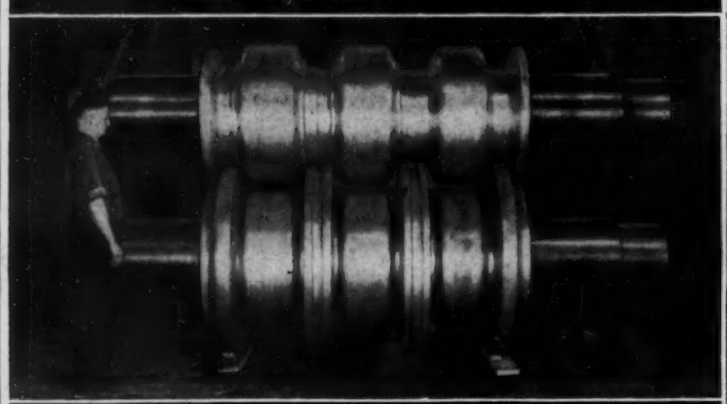
Gear Rims Used for Ship Propulsion Drives
are Forged in one Piece from a Solid Ingot



Finishing 55 Ft. Propeller Shaft for a Cruiser,
Showing Bronze Sleeves Mounted on Shaft.
Shafts for all Types of Ships are Forged,
Heat Treated and Machined Complete in the Mesta Plant



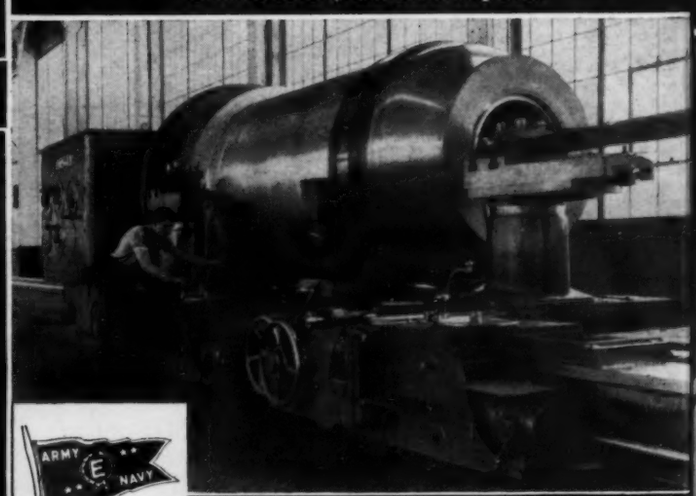
Aluminum Strip Entering
Finishing Stand of a Four-High Tandem Hot Mill



Mesta Special Alloy Steel Rolls for 18" Beams.
Rolls are Designed by Mesta for any Section
and Furnished with the Necessary Tools, Templates and Guides

Teeming from Two Ladles Simultaneously 440,000 Pounds
of Open Hearth Steel to Form an 108" Forging Ingot

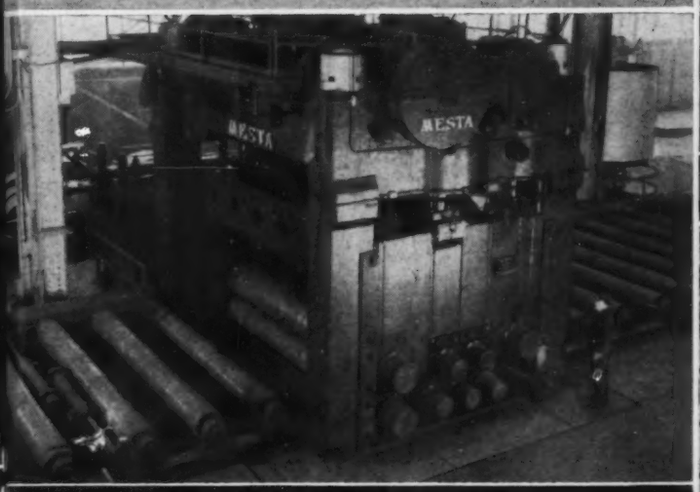
Four Stand Tandem Four-High Mill for the Cold Reduction
of Thin Sheet Strip and Galvanizing Stock



Finishing a Single Piece Forged Steel Press Cylinder
in a 96" Mesta Combination Boring & Turning Lathe

MESTA MACHINE CO.,

MESTA



Mesta 195" Backed-Up Roller Leveller
for Straightening Cold Armor Plate

140" Four-High Reversing Plate Mill
Designed and Built by Mesta

Mesta 21"—18"—14"—10" Merchant Mills,
with Pack Annealing Cooling Bed and Equipment

A 16" Gun Being Maneuvered on Carriage
in Barbette Department Where Three Such Units
may be Handled Simultaneously Under One Roof

46" Reversing Slabbing-Blooming Mill,
Showing Tables and Manipulators

Mesta Produces in a Special Department Many Guns
for Our Armed Forces Including the Largest Regularly Used

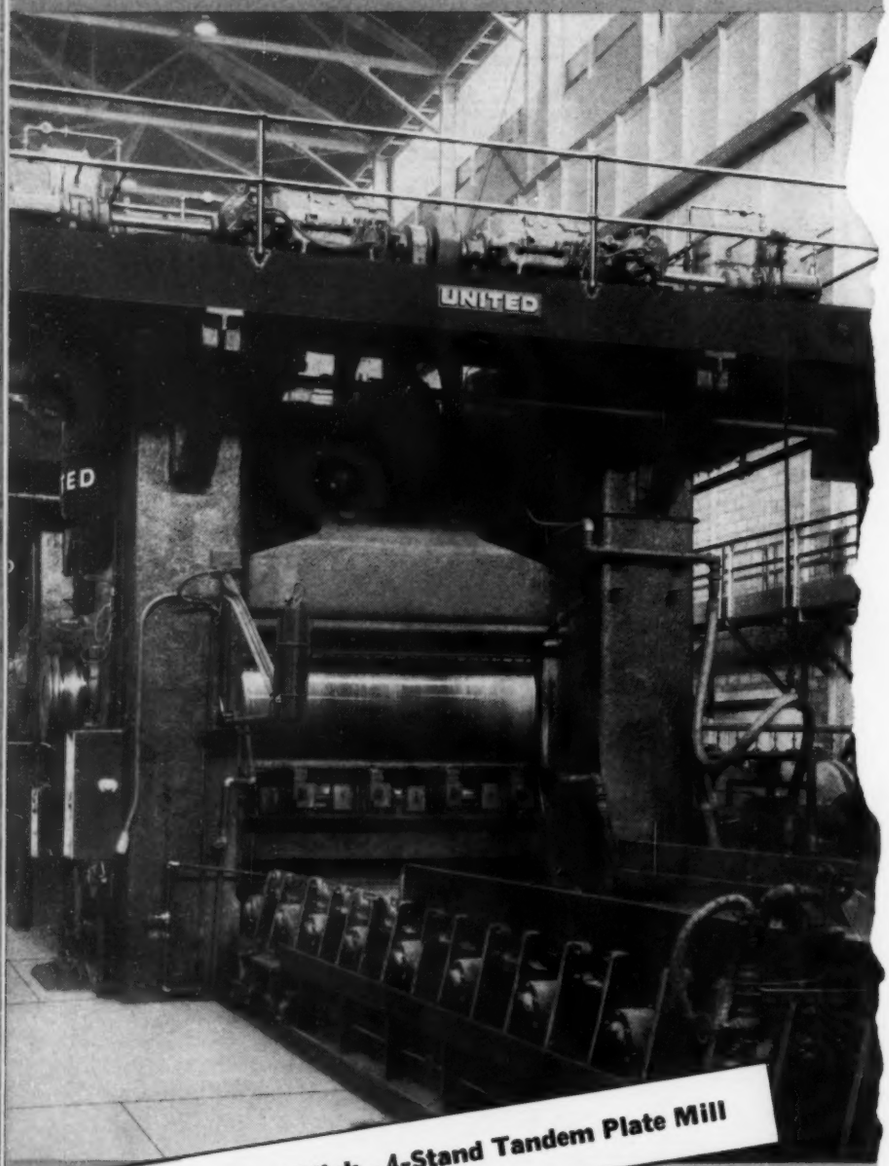
Group of Mesta Forged, Hardened, Alloy Steel
Working Rolls for Cold Mills

• • PITTSBURGH, PA.

UNITED Plate Mills

Builders of

- ☆ The FIRST 4-High Reversing Plate Mill
- ☆ The FIRST Semi-Continuous Plate Mill
- ☆ The WORLD'S LARGEST Plate Mill



UNITED 100" 4-High—4-Stand Tandem Plate Mill

To meet war requirements we greatly increased our Rolling Mill production facilities. Very soon we expect to be able to offer attractive deliveries on units duplicating existing designs of all types and all sizes of PLATE MILLS, or modifications of them adapted to meet your specific requirements.

Recognized pre-eminence in technical research, and more than 40 years experience in the design, construction and installation of Rolling Mills and their auxiliary equipment for leading steel manufacturers throughout the world, is evidence of UNITED'S ability to serve you.

In planning for present or post-war expansions, you should consult with our engineering staff.

- ☆ 3-High Plate Mills
- ☆ 2-High Reversing Plate Mills
- ☆ 4-High Reversing Plate Mills
- ☆ Semi-Continuous Plate Mills
- ☆ Auxiliary Equipment

U.E.&F.CO.

Reg. T. M.

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PITTSBURGH, PENNSYLVANIA

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Davy and United Engineering Company, Ltd., Sheffield, England
Dominion Engineering Works, Ltd., Montreal, P. Q. Canada

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FLAT PLATE AFTER QUENCHING!

DREVER PRESSURE QUENCH STRAIGHTENING AND QUENCHING PLATE (8′ x 34′ x ⅜″) at the Homestead Works of CARNEGIE-ILLINOIS STEEL CORP.

THE Drever Pressure Quench shown above is the largest built to date. It quenches, and straightens while quenching, ⅜″ armor plate which is 8 feet wide and 34 feet long.

Production reports from Carnegie-Illinois state that the plate quenched in this hardening quench requires no further straightening, and remains flat before fabrication.

This installation is another example of the foresight of a user in seeking a modern solution for a problem, and the ability of Drever engineers to design specialized equipment to meet their requirements.

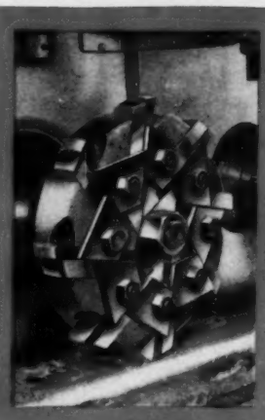
THE DREVER CO.

740 E. VENANGO ST., PHILA. 34, PENNA.

PRESSURE QUENCHES · CONTINUOUS FURNACE LINES · HEAT TREATING FURNACES

Billeteers

• MECHANIZE • FOUR BILLET • CONDITIONING •

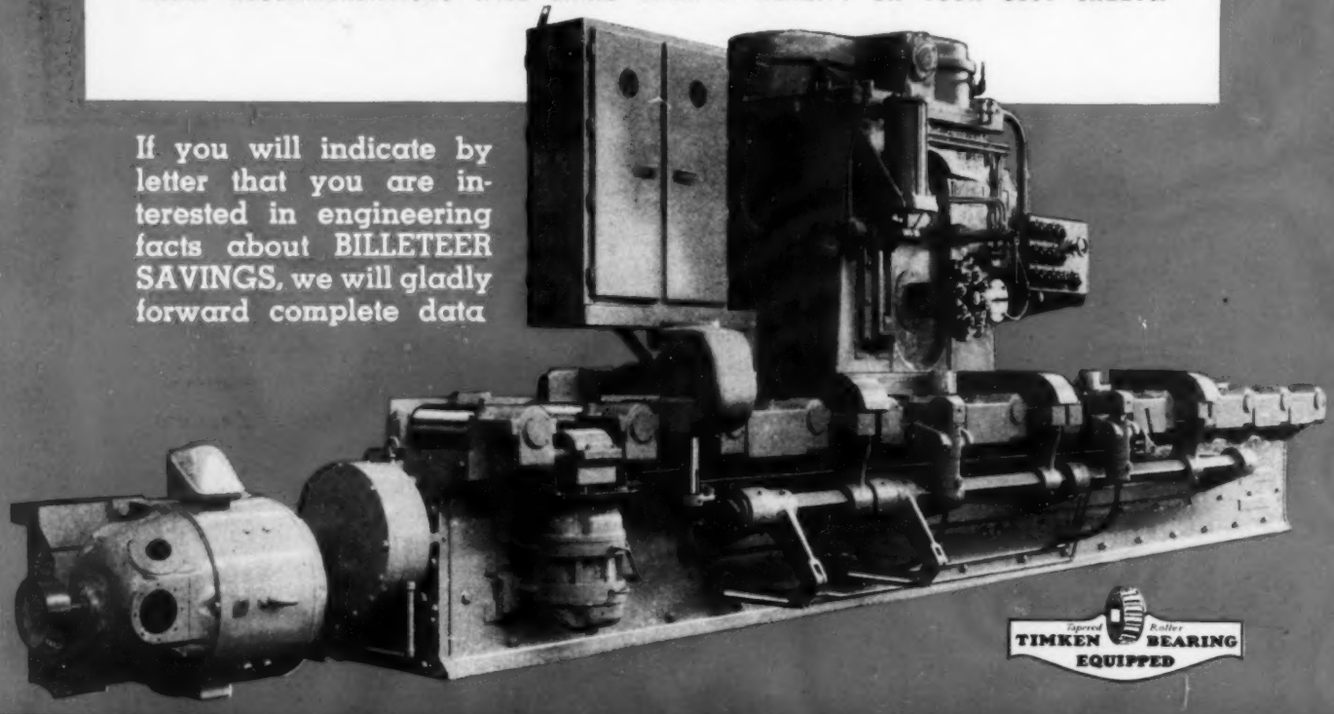


clean faster, better and at less cost than by any other method

- LOWER BILLET CLEANING COSTS—All users report savings. One averages $2.50 per ton.
- LOWER FIRST COST—Compared with returns on other equipment.
- LOWER UPKEEP COSTS—Compared with tools, repairs and supplies for 20 manual chippers.
- LOWER ENERGY CONSUMPTION—Savings better than 60 per cent.
- LOWER "HEAT" LOSSES—Whole heats that go bad can be salvaged.
- LOWER LABOR TURNOVER—One OPERATOR vs. 20 fast changing laborers.
- LOWER OVERHEAD COSTS—Compare costs in personnel records, space, accommodations and headaches

THESE SAVINGS ARE A BOON TO THE ENGINEERING AND PRODUCTION STAFFS — THEIR RECOMMENDATIONS WILL MAKE THEM A REALITY ON YOUR COST SHEETS.

If you will indicate by letter that you are interested in engineering facts about BILLETEER SAVINGS, we will gladly forward complete data



Tapered Roller TIMKEN BEARING EQUIPPED

STEEL EQUIPMENT DIVISION OF **THE BONNOT COMPANY, CANTON, OHIO**

BONNOT

ENGINEERED FOR IMPROVED PRODUCTION

WRITE US FOR COMPLETE FACTS

A·B·K
Laminated Plastic Bearings
keep 'em rolling—at less cost

KEEPING Victory mills rolling 24 hours a day is a tough job. But not in mills using A-B-K plastic bearings.

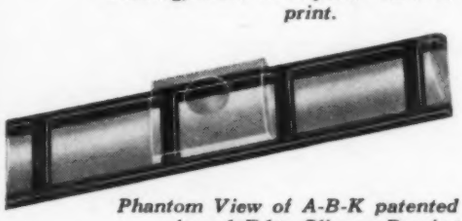
A-B-K plastic bearings have established records for long service, for tonnage rolled, for eliminating lost time due to shutdowns and for reducing power consumption in large plants.

Materials used in A-B-K were developed by American Brakeblok research engineers to provide an unusually low coefficient of friction. A-B-K bearings are made to a tested formula in one of the most modern plants in America, and are furnished to size ready for installation without extra machining.

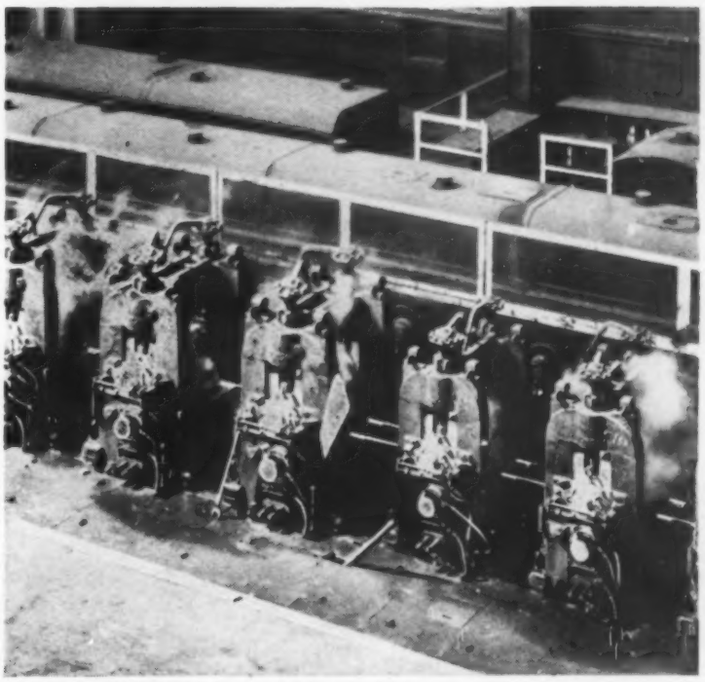
The research and engineering facilities of A-B-K are available for recommendations on your bearing problems. Write American Brakeblok Division, Detroit 9, Michigan.

Typical A-B-K Roll Neck Bearing with separate thrust collar.

A-B-K Patented Reinforced Edge Slipper Bearing, made in required sizes to blueprint.



Phantom View of A-B-K patented Reinforced Edge Slipper Bearing.



Industrial and Marine Uses
A-B-K Laminated Plastics

- Textile Mills
- Steel Mills
- Rubber Mills
- Industrial Truck Wheels
- Paper Mills
- Marine Stern Tube Bearings
- Pintle Bearings
- Rudder Bearings
- Etc.

American Brakeblok
TRADE MARK REG. U.S. PAT. OFF.

DIVISION OF AMERICAN Brake Shoe COMPANY

When the President started in as a catcher...
Even in those distant days the present executive head of his company was familiar with Lewis Rolls. Their ability to turn out greater tonnage, better finish, fewer rejects with less time out for roll change had a good effect on his weekly pay envelope. Today he has to worry about taxes, directors, stockholders and profits, but not about rolls . . . for they're still rollin' with Lewis!
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BUY U. S. WAR BONDS AND STAMPS
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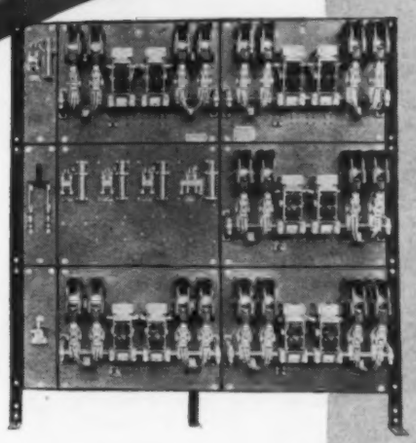
LEWIS ROLLS
Also manufacturers of
ROLLING MILL MACHINERY
for the iron, steel and non-ferrous industries

EC&M 2300 VOLT WOUND-ROTOR *Motor* CONTROLLER

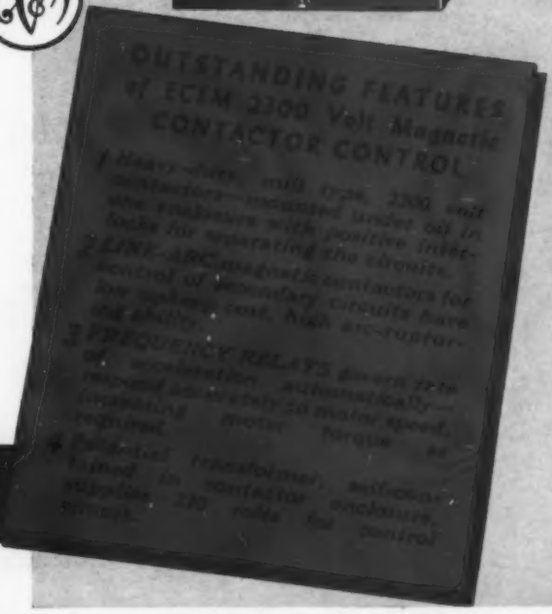


For 2300 volt, wound-rotor motors, EC&M Non-reversing or Reversing Control is without equal. And for the primary, high voltage switching requirements, Type ZHS Magnetic Contactors are used.

These contactors are of compact design and oil-immersed, with the control circuit potential transformer, in a single shock-proof enclosure. For reversing applications, as used on this 18-inch mill, two contactors are mounted back-to-back with heavy, mechanical interlock-bar between them and enclosed under oil in one tank.

Panels for controlling the secondary, or rotor, circuit consist of *LINE-ARC* Contactors and Frequency Acceleration Relays. Type NX Master Switch gives speed control.

Specifications of these EC&M Wound-rotor Motor Controllers are given in Bulletins 1062-C, 1140-B, and 1182-2. Write for your copies.



THE ELECTRIC CONTROLLER & MFG. CO.

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Rates "TOPS" with Industry

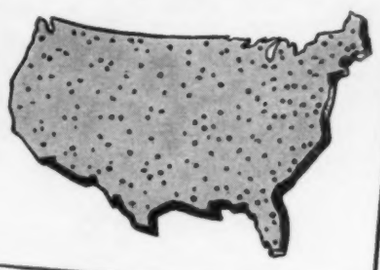
for these 3 important reasons

You can depend on National Carbide—the famous "carbide in the red drum". More than a quarter century of widespread use has established the economy, uniformity and productivity of this quality carbide.

National Carbide is available in all sizes for generator use—packed in standard size drums. For the address of your nearest National warehouse or distributor, write to Air Reduction's New York office, Dept. IS.

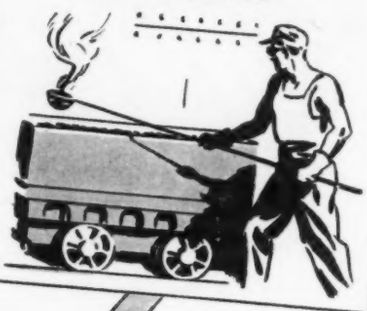
1. NATION-WIDE LOCAL DISTRIBUTION

Prompt deliveries in large or small quantities from more than 250 warehouses located in or near all major manufacturing centers. Also supplied by local dealers and distributors.



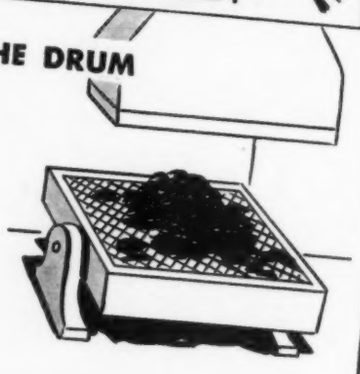
2. HIGH ACETYLENE YIELD ASSURED

Hourly testing and the use of exceptionally fine quality materials and strictly-controlled manufacturing procedures, produce a carbide practically free from impurities.



3. DUST-FREE IN THE DRUM

Because National Carbide is screened with extreme care. It is carefully packaged under strict supervision in air-tight drums in order to prevent contamination and deterioration.



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AIRCO ACETYLENE GENERATORS

Ideal Team-mates for National Carbide

For dependable volume production of acetylene, use National Carbide in Airco Acetylene Generators. Five sizes to choose from—15 lb., 30 lb., 50 lb., 300 lb. and 500 lb. single or double rated. The first three sizes are portable types and the latter two are stationary. These generators are listed by the Underwriters Laboratories, Inc. Write to Air Reduction's New York office for descriptive folder ADC 619, Dept. IS.

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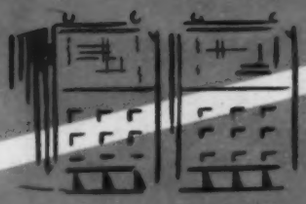

TATE-JONES INDUSTRIAL FURNACES

SERVICE FIRST AND LAST!

Tate-Jones, one of the pioneers of the industrial furnace industry and one of the oldest manufacturers of this equipment in continuous operation, offers an exclusive service to those engaged in heat-treating procedures. In addition to designing and constructing the most efficient and economical industrial furnaces, Tate-Jones applies the combined skills of its metallurgical and engineering personnel to help furnace operators reduce heat-treating costs by eliminating re-treating through the application of quenching methods that are condusive to greater uniformity in hardness, improved physical properties and the elimination of cracking. They also help obtain improved and controlled structures from the quench in order to assure greater machinability.

It's a case of "service, first and last". Upon receipt of the necessary data, Tate-Jones ❶, prescribes a furnace that will do that particular job and submits metallurgical suggestions for producing finished parts of specified hardness, physical properties and structure. ❷, if a large furnace, it is erected and assembled on the customer's premises. Smaller furnaces are assembled at the Tate-Jones plant and shipped as a complete unit ready for use. ❸, after the heat-treating equipment is installed, Tate-Jones Engineering Service continues until the required product is obtained.

Tate-Jones does not consider the sale of a furnace the end of a transaction, but rather maintains its policy of service by continually offering the advantages of its forty-five years experience on any metallurgical heat-treating problem.

Let these men be of service to you.

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B. J. AURIN
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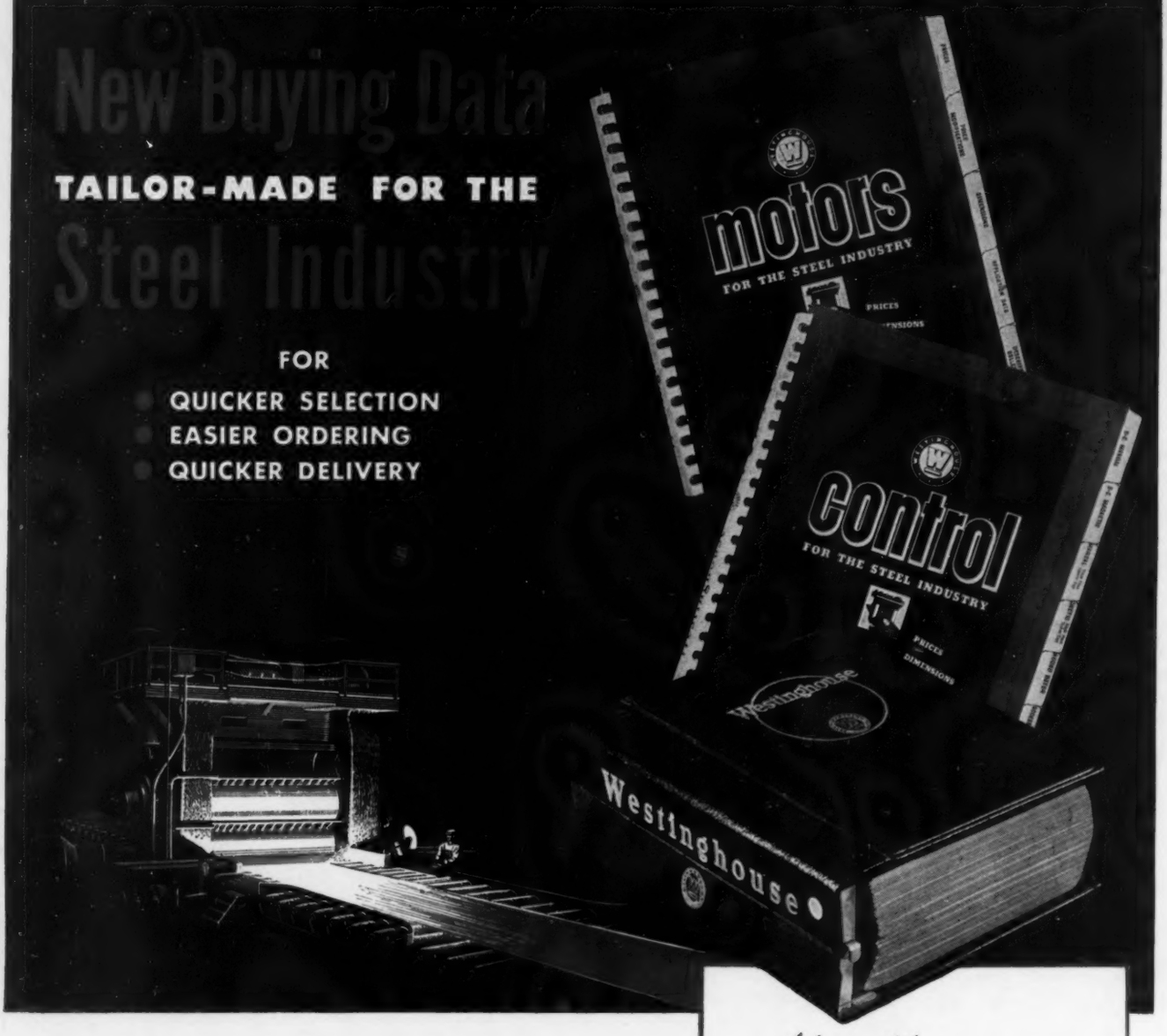
& CO. INC. · LEETSDALE (Pittsburgh District) PA.

Rotating Hearth, Car Bottom, Pusher, Conveyor, Roll Down, Horizontal and Vertical Pit, Circular and Rectangular Pot Furnaces. Also Gas, Oil and Combination Burners

New Buying Data
TAILOR-MADE FOR THE Steel Industry

FOR
- QUICKER SELECTION
- EASIER ORDERING
- QUICKER DELIVERY



Whether it's a question of main drive motors and control or smaller drives for auxiliaries, you'll find all the pertinent facts on them *easier . . . quicker . . .* in this new, clear, easy-to-read Steel Industry Buying Data.

Data, as presented, is striking in its newness, and easier to use than any offered previously by any manufacturer. This new Buying Data is available in two forms:

PLASTIC-BOUND BOOKS — Designed for use by the majority of motor and control buyers. These catalogs contain prices for estimating purposes, plus product dimensions, application data and descriptive bulletins.

"Motors for the Steel Industry" covers popular types and ratings of motors engineered for steel industry service, Gearmotors and M-G sets.

"Control for the Steel Industry" lists a wide variety of controllers and accessories for direct-current, single-phase, squirrel-cage and wound rotor motors.

LOOSE-LEAF CATALOG—This is for the use of frequent purchasers and is "tailored" to meet the needs of the individual buyer. Pricing data is always kept up to date by the issuance of new price supplements. J-94622

Here's How **TO GET THIS NEW BUYING DATA**

If you are a buyer of motors and control and have not received your copy, write, wire or phone your nearest Westinghouse district office (no mailings from Westinghouse Headquarters at East Pittsburgh). Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

MOTORS AND CONTROL FOR THE STEEL INDUSTRY

Thinking about Tomorrow?

Are you set for stiffer competition? Would lower production costs, larger output or increased quality of product help? Perhaps Mackintosh-Hemphill can help you . . . In the engineering, metallurgy and manufacturing of the type of equipment they make, they are a proved source of advanced industrial thinking . . . For instance, seven mills have set new tonnage records with M-H Technalloy Blooming Mill Rolls. Two of these records being *double* the best previous performance . . . These rolls are made of enriched true alloy steel, especially heat treated for hardness of body surface and tempered to a toughness that resists spalling and fire cracking. The journals are tough and strong and well able to withstand imposed stresses. The service these rolls deliver speaks for itself.

EXPERIENCE FOR SALE

Mackintosh-Hemphill's experience has been accumulating for 140 years. It is the solid foundation upon which present, progressive M-H technical minds have built their international reputation for successful industrial leadership. Today its benefits are available to you through their cooperative consulting service on the mechanical engineering end of industrial production equipment.

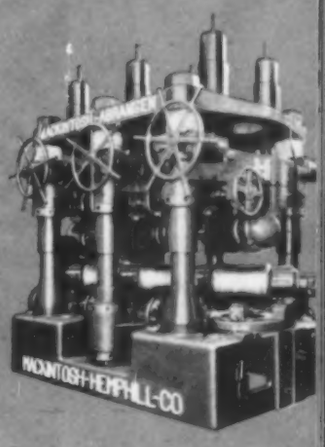
The history of M-H industrial developments is exceptionally comprehensive and continuous.

IN 1812 M-H produced cannon and cannon balls for Perry's fleet.

IN 1861 M-H made the first 20 inch guns in the world.

LAST YEAR M-H made the world's largest gun mount castings for the new 16 inch coastal defense rifles.

TODAY M-H has just completed the Mackintosh-Abramsen 6 roll straightener shown at the right. It straightens solid bar stock and tubing, hot or cold, from end to end — IT REMOVES END BENDS.



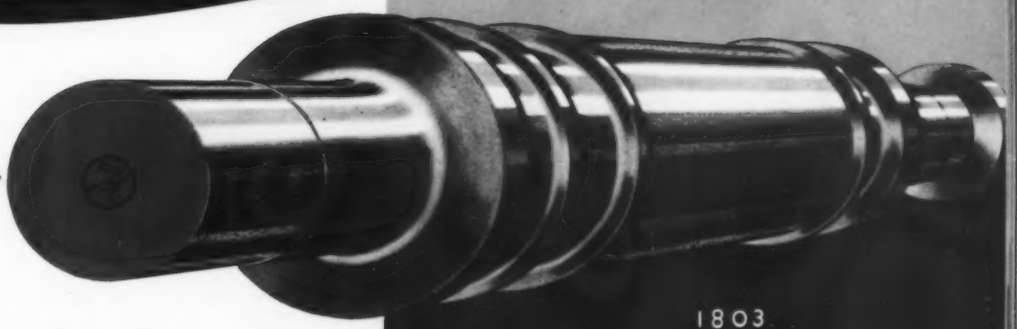
OTHER PRODUCTS:

Rolling Machinery . . . Shape Straighteners . . . Strip Coilers . . . Shears . . . Levellers . . . Pinions . . . Special Equipment . . . Iron-Steel Castings . . . Improved Johnston Patented Corrugated Cinder Pots and Supports . . . Heavy Duty Engine Lathes.

Install Technalloy *blooming mill rolls*

THE ROLL WITH THE RED WABBLERS

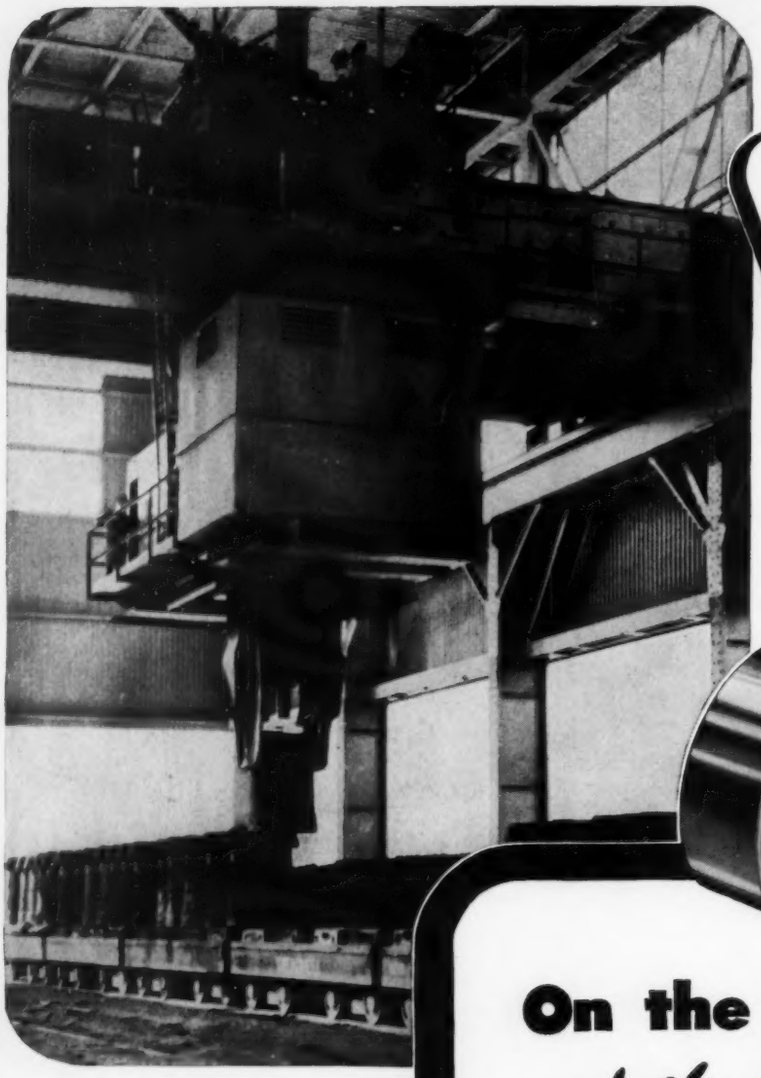
THEY ROLL MORE TONS PER DRESSING



1803 MCO

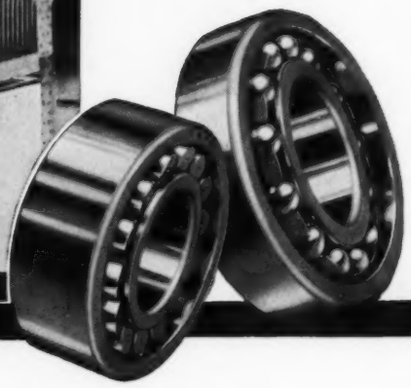
MACKINTOSH-HEMPHILL COMPANY

Pittsburgh and Midland, Penna.



Built by
ALLIANCE
MACHINE CO.

This Stripper-Crane is located at the New Kaiser Steel Plant at Fontana, California.



On the Lifting Jobs *of the Steel Industry*

Many are the tough jobs put up to SKF Bearings in the Steel Industry, and one of the toughest is on the lineshaft of this 200-ton Stripper-Crane with 61'-6" span. Loads are heavy when this unit strips ingot from mold, but they're not too heavy for four SKF Spherical Roller Bearings. Completely self-aligning, SKF's have high radial and thrust capacity, full surface contact between rollers and guide flange, assuring accurate roller guidance and low friction. Their equalized load distribution insures full bearing capacity and long life. All these advantages—and many more—are important in giving a lift to the Steel Industry's production program. 5638

SKF INDUSTRIES, INC., PHILA. 34, PA.

SKF

ball and roller bearings

A SINGLE OBJECTIVE.....

Production Control

A SINGLE RESPONSIBILITY IN ACHIEVING IT

Higher tonnage and uniform quality of product result from efficient control of steel mill equipment. An invaluable aid in achieving this is a system of automatic controls and instruments that allows operators to concentrate on the factors making for optimum production. To secure these results, Republic Flow Meters Co. offers a complete manufacturing and engineering service—a single responsibility—in the field of measurement and control. We will gladly co-operate with you in the solution of any metering or control problem. Your inquiries involve no obligation.

FURNACE CONTROLS
For furnace pressure, fuel, fuel-air ratio.

BOILER CONTROLS
For all boilers, all types of firing.

REGULATORS
For pressure, flow, speed, level, ratio.

GAS MIXER CONTROLS
For mixing gases in desired ratio.

COKE OVEN GAS CONTROLS
For collecting mains, stack draft, pressures.

RING-BALANCE METERS
For steam, water, gas, air, oil, etc.

ELECTRICAL FLOW METERS
For steam, water, gas, air, oil, etc.

FURNACE PRESSURE RECORDERS
For pressure in all types of furnaces.

DRAFT & PRESSURE INDICATORS
For draft, pressure, flow, temperature, CO_2, etc.

THERMOMETERS
For temperatures up to 1000 F.

DATA BOOKS MAILED ON REQUEST

REPUBLIC FLOW METERS CO.
2220 Diversey Parkway, Chicago, Illinois

HARD TO BEAT

On the basis of cost per ton of steel rolled, Pittsburgh Rolls are way out in front. The reason for their superior performance is sound enough —they carry the mark of a concern whose one and only product is rolls for rolling mills!

BUY U. S. WAR BONDS AND STAMPS

PITTSBURGH ROLLS

PITTSBURGH ROLLS DIVISION of BLAW-KNOX CO. — "Steel's Partner" • PITTSBURGH, PA.

"3C" APPLICATIONEERING ON SHEARING LINES *and/or* OTHER HEAVY DUTY OPERATIONS

"3C" SHEARING LINE CONTROL

This is a typical "3C" Heavy Duty Electrical Control installation, for a Shearing Line. Dead Front Panels provide safety and neatness, while the full swinging doors permit easy and instant examination of wiring and terminals.

At the far end, "3C" Bulletin 7400 D.C. Magnetic Contactors take the brunt of the heavy operation of 8 motors with a total of 167 H. P., plus a 50 KW M.G. set.

A Shearing Line is rapidly operated, is subject to sudden braking, and runs for long periods.

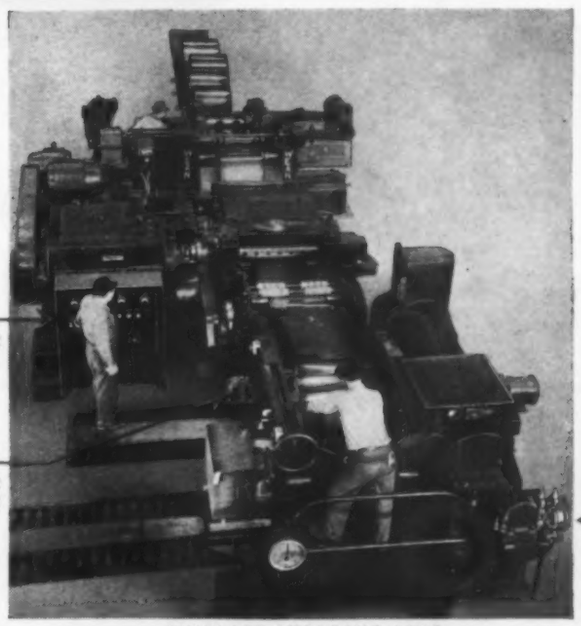
To meet these conditions, all parts of "3C" Bulletin 7400 D. C. Magnetic Contactors are sturdily built for ample strength during racking operation. Nitralloy pins are held in place in Nitralloy bushings by a ball and spring device which permits easy removal of pin.

Main contact tips are duplicate cold drawn copper, accurately formed, and operate with a wiping action which keeps the contacts clean with minimum abrasive wear.

Bulletin 7400 D.C. Vari-Time Contactors, incorporating a timing device within themselves, providing an adjustable time delay before closing, are also used.

These Vari-Time Contactors are ideal in motor accelerating service, as they eliminate accelerating relays, thus simplifying wiring, and the timing element needs no maintenance nor repair.

Your electrical control problems will receive the same careful applicationeering attention that has developed thousands of successful installations of "3C" apparatus.

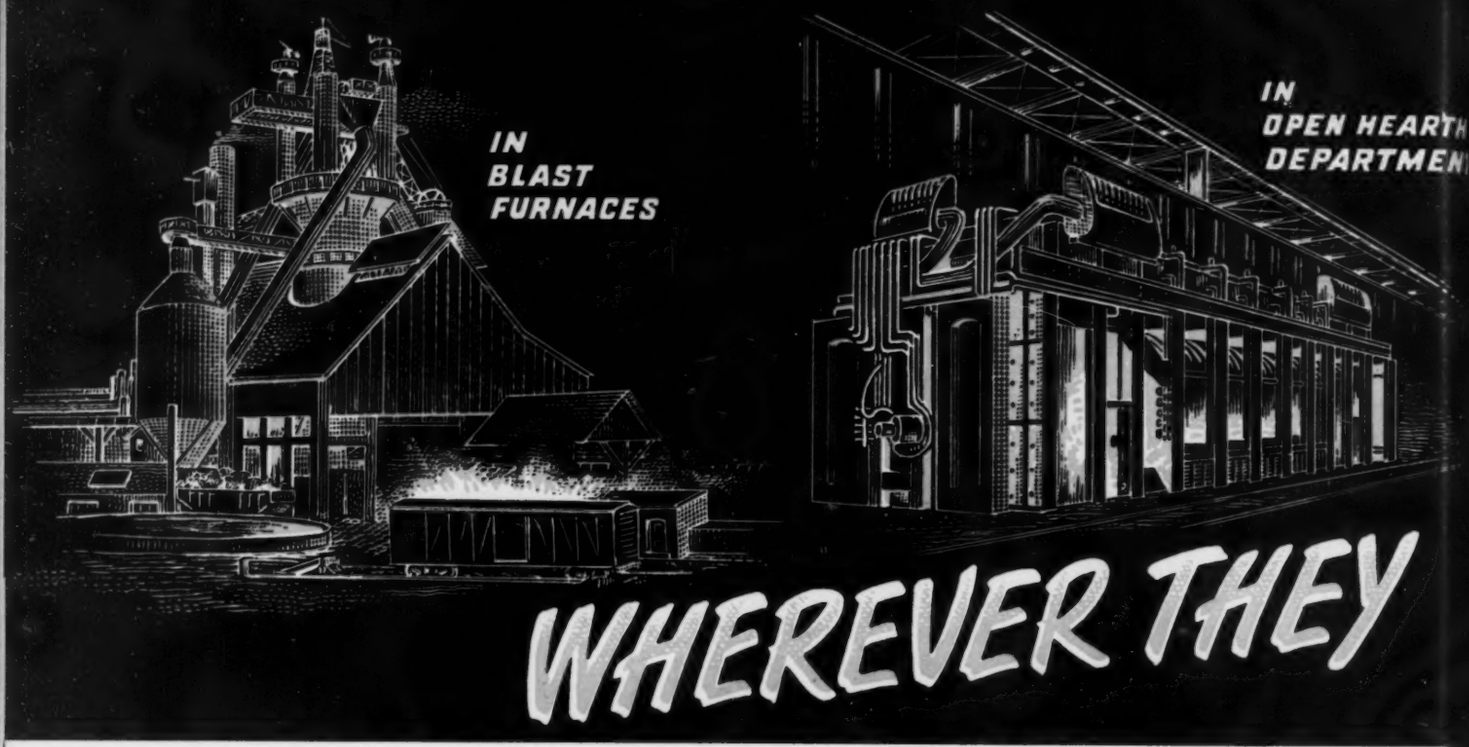


TINPLATE SHEARING LINE

CONTINUE TO ROLL WITH CLARK CONTROL

THE CLARK CONTROLLER CO.

1146 EAST 152ND ST. CLEVELAND, 10, OHIO



WHEREVER THEY

"TOOL STEEL"

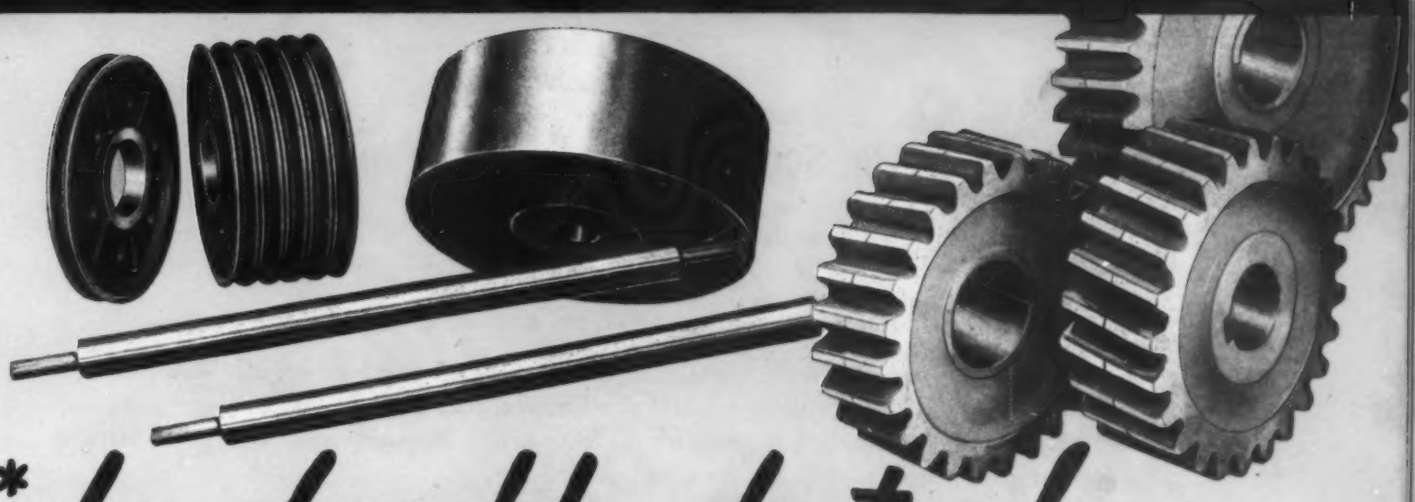
GEARS · PINIONS · WHEELS · ROLLS

AND HARDENED PRODUCTS

ON MILL TABLES

ON ALL MISCELLANEOUS EQUIPMENT

GO TO WORK



*do double duty!

*THEY SEND PRODUCTION UP AND FORCE MAINTENANCE COSTS DOWN

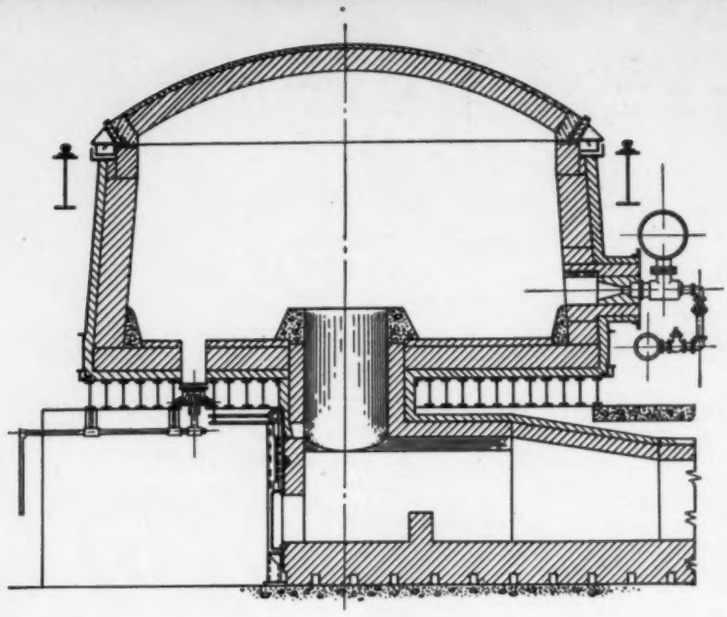
"TOOL STEEL" hardened products perform vital functions in maintaining lowest cost operations in every department.

* **This is no idle boast. "TOOL STEEL" products are sold under a Make Good or Money Back Guarantee.**

THE TOOL STEEL GEAR & PINION COMPANY

CINCINNATI, OHIO

7 OPERATING ADVANTAGES • SALEM CIRCULAR SOAKING PIT



Sectional view of a Salem 20' diameter Circular Ingot Heating Furnace.

As Demonstrated in Scores of Installations in America's Mills

1. Uniform temperature through the use of a multiplicity of small burners evenly spaced around the furnace wall.
2. Constant furnace atmosphere by means of an automatic fuel-air ratio control.
3. Maximum rate of heat transfer without injury to the surface of the ingots. The products of combustion whirl rapidly around the furnace, transferring heat to the ingots, and diluting the extremely hot gases which form at the burner ports. The gases exhaust through a center flue in the furnace bottom.
4. Any fuel can be adapted on either a continuous or intermittent basis.
5. Accurate control and uniformity of heat distribution permit most exacting heat treating practices.
6. Minimum scale loss assured by accurate temperature control and automatic atmosphere control.
7. Furnace can be cooled quickly or brought up to proper temperature fast because of the relatively small amount of brick in the design.

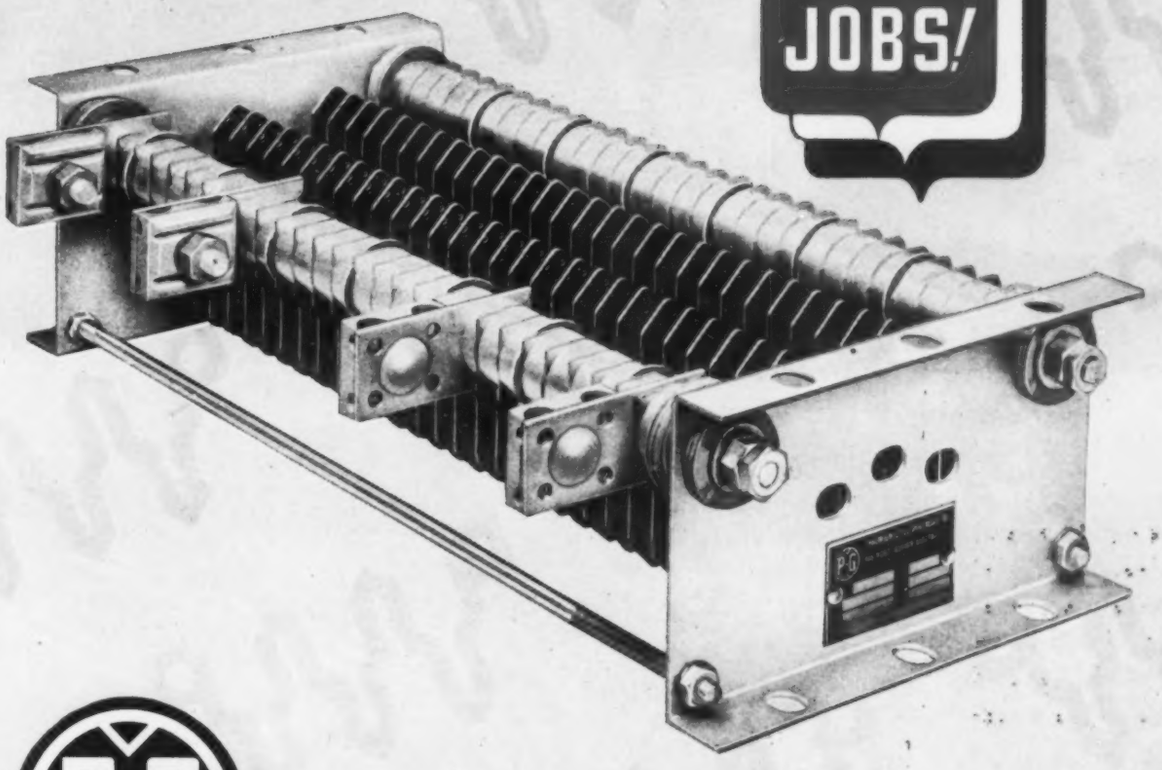
One superintendent who has used a 20' Salem Circular Soaking Pit for more than six years says—"I like the Salem Pit because our records prove we save substantially on each ton of steel prepared in the Salem Pit."

Salem can show you how to cut conditioning costs . . . Prompt attention to your inquiry.

SALEM ENGINEERING COMPANY

SALEM ENGINEERING CO.
SALEM, OHIO

For THOSE TOUGH JOBS!



P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

MODERN EQUIPMENT for

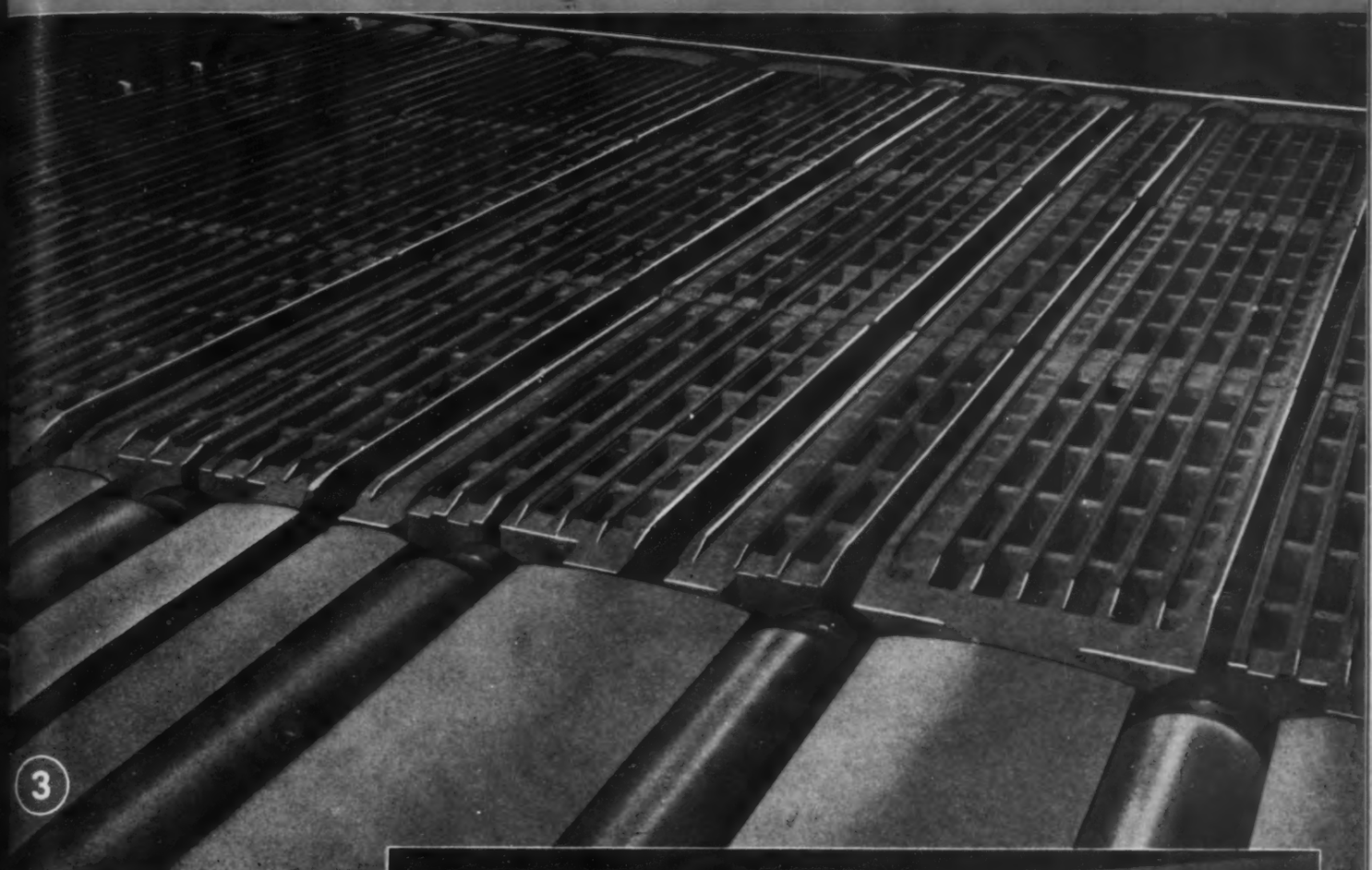
1 Run-in and Run-out Roll Tables, with Hot Bed and Reversible Transfer. Shear Approach Tables with Kickoffs and Stacking Beds in the background.

•

2 Roll table Kickoff and Adjustable Stacking Beds.

PALMER-BEE COMPANY, DETROIT

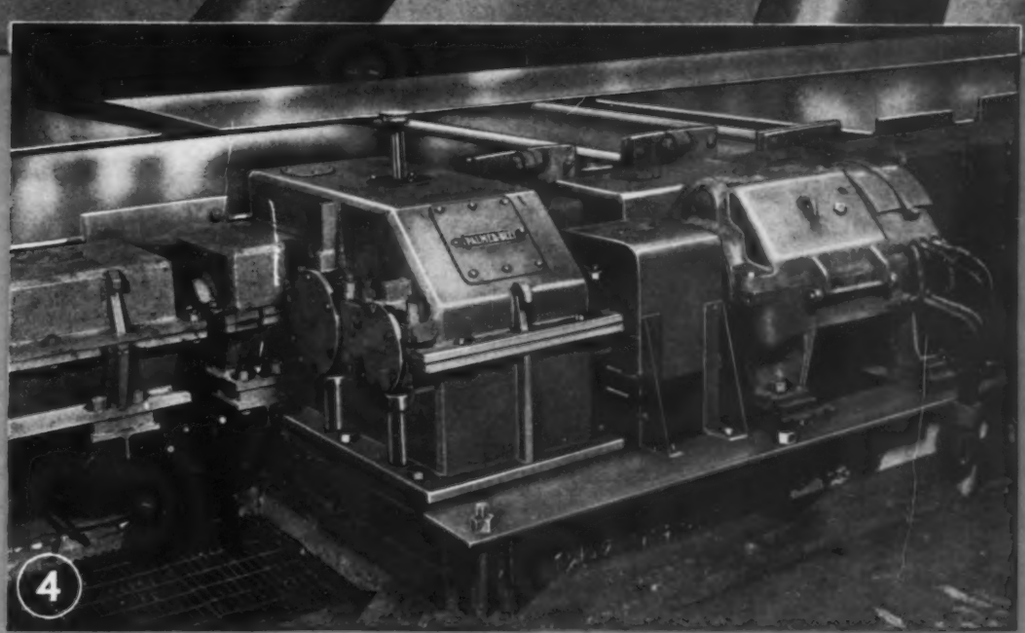
THE STEEL PLATE MILL



3 Close-up view of Roll Tables, Hot Bed Grids and Reversible Dogs.

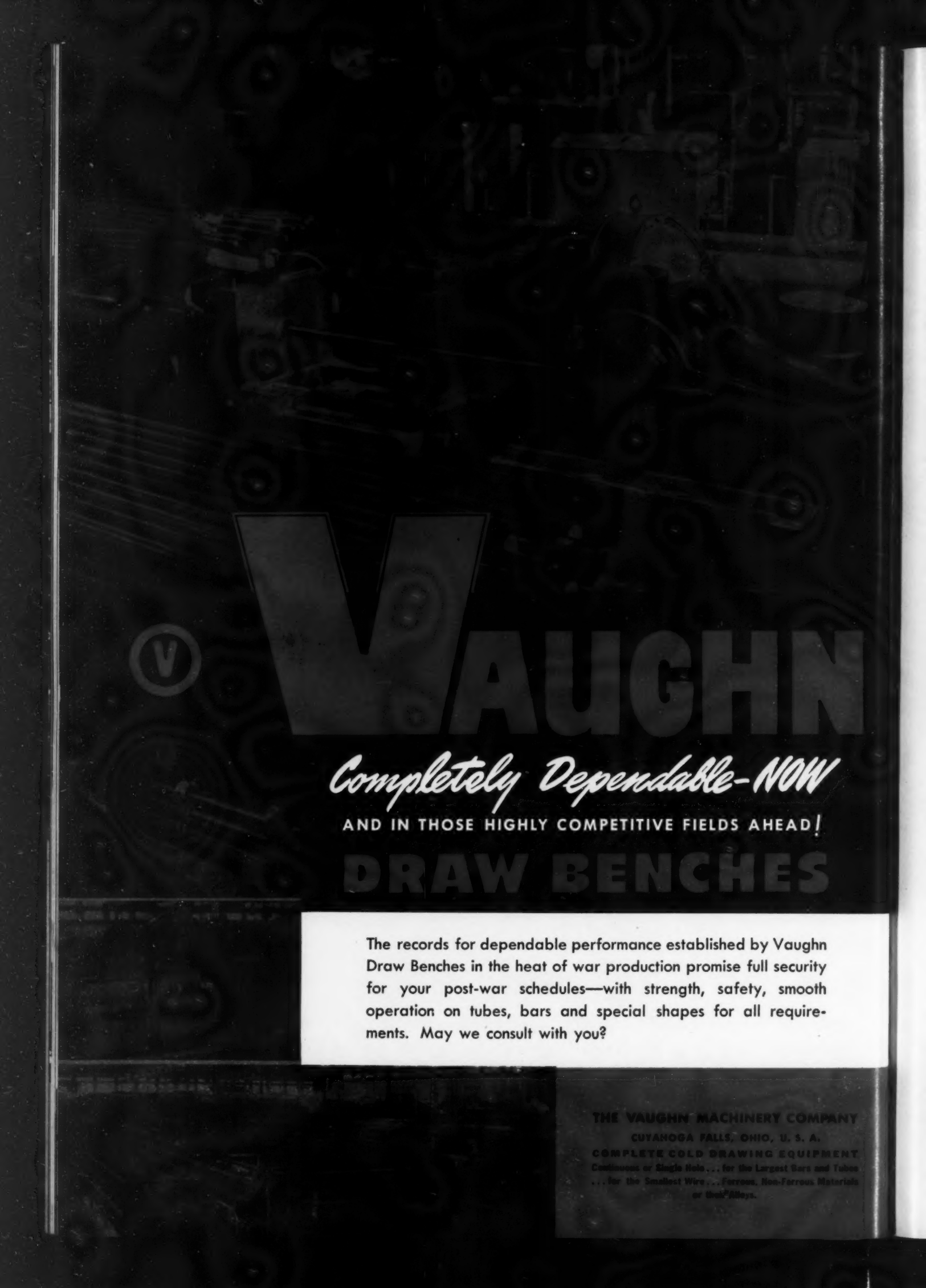
•

4 Typical table drive with line shaft mitre gear boxes.



ENGINEERS AND BUILDERS OF STEEL MILL EQUIPMENT: Up-enders and Down-enders, Soaking Pit Cover Lifters, Plate Turnover Rigs, Stacking Beds, Roll Tables, Hot Beds, Inspection Tables, Slab Transfers, Pilers, Tilters, Transfer Chains, Roller Conveyor, Oiling Machines, Coil Conveyers, Self Aligning Roller Bearing Pillow Blocks with Cast Steel Housings, Transfer Cars, Herringbone Speed Reducers.

PALMER-BEE COMPANY, DETROIT


VAUGHN
Completely Dependable-NOW
AND IN THOSE HIGHLY COMPETITIVE FIELDS AHEAD!
DRAW BENCHES
The records for dependable performance established by Vaughn Draw Benches in the heat of war production promise full security for your post-war schedules—with strength, safety, smooth operation on tubes, bars and special shapes for all requirements. May we consult with you?
THE VAUGHN MACHINERY COMPANY
CUYAHOGA FALLS, OHIO, U. S. A.
COMPLETE COLD DRAWING EQUIPMENT
Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

★ ★ WAGNER PRODUCTS FOR VICTORY ★ ★

Wagner
UNIT SUBSTATIONS
PROVIDE LOAD CENTER CONTROL FOR LIGHTING AND POWER CIRCUITS

The Unit illustrated above is installed in a synthetic rubber plant. Each transformer has a two-position liquid-filled disconnecting switch on the high-voltage side which is equipped with low-voltage interlock. The low-voltage side is equipped with air circuit breakers electrically or manually operated, ground indication lights, voltmeters, ammeters, and ammeter test blocks. Each unit has one main breaker, one tie transfer breaker, and two feeder breakers.

MOTORS
TRANSFORMERS
UNIT SUBSTATIONS
INDUSTRIAL BRAKES
BRAKE LINING

For Complete Information on Wagner Unit Substations write or phone the nearest Wagner branch office.

BACK THE ATTACK—
BUY U. S. WAR BONDS

NATIONAL SECURITY AWARD

T44-3

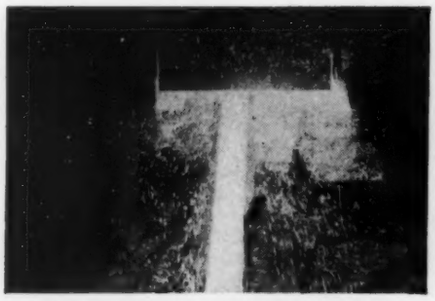
Wagner Electric Corporation
ESTABLISHED 1891
6483 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

LINDE METHODS AND EQUIPMENT

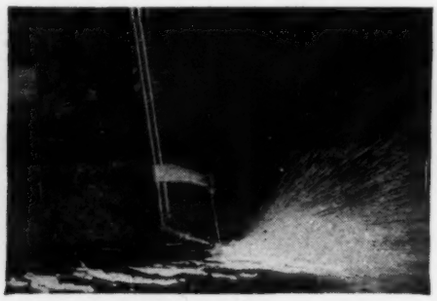
HELP TO MAINTAIN PRODUCTION AND TO LOWER OPERATING COSTS

Oxy-acetylene processes are used throughout industry to speed up production, to conserve materials, to lower operating costs, and to simplify maintenance and repair. Some of the many oxy-acetylene applications are outlined here.

WELDING with the oxy-acetylene flame makes possible the joining of practically any metals—like or unlike—so that the weld is as strong as the base metal itself. *Bronze-welding* speeds the repair of cracked or broken steel and iron parts right on the job. *Resurfacing* of worn parts with steel, iron, bronze, or other types of welding rod avoids delays and conserves materials. *Hard-facing* with HAYNES STELLITE alloys makes parts that are subject to abrasion, heat, or corrosion last from two to twenty-five times longer. *Welded piping* systems use less fittings, occupy less space, and remain leakproof and maintenance-free indefinitely.



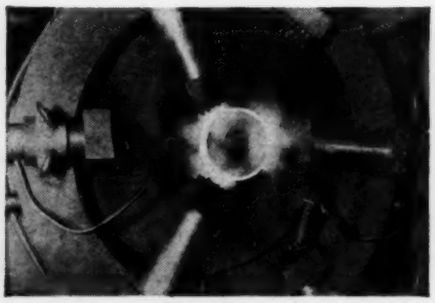
MECHANIZED CONDITIONING —Slabs, blooms, and billets are freed of surface defects over their entire area by means of oxy-acetylene machines installed on the roll table. Productive yield is thus increased.



HAND-DESEAMING—Where mechanized conditioning of steel is not feasible, or for use in secondary conditioning, oxy-acetylene deseaming with manually operated Oxweld equipment is a quick, economical, and effective method.

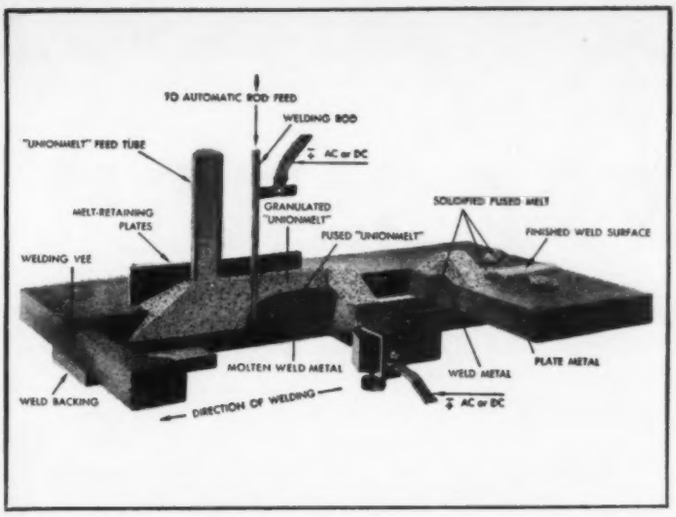
BAR AND BILLET CUTOFF — Oxwe'd flame-cutting machines, both portable and stationary, tremendously speed up and lower the costs of cutting off such parts as shell rounds, forging blanks, disks, and etch test specimens.

FLAME-SHAPING — For the fast production of simple or intricate shapes—for straight-line cutting—for cutting circles, disks, and gear blanks—and for plate edge preparation—a complete line of Oxweld flame-cutting machines has been developed.

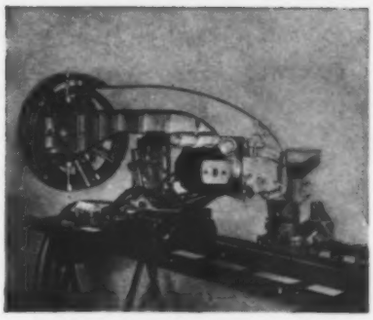


FLAME-HARDENING — Oxy-acetylene flame-hardening imparts a hard, wear-resistant case to steel and iron parts of any size or shape without affecting the chemical composition or toughness of the core.

FLAME-DESCALING— This method is generally faster and more economical than pickling, sand-blasting, wire brushing, and grinding for the removal of mill scale and other undesirable encrustations from steel.

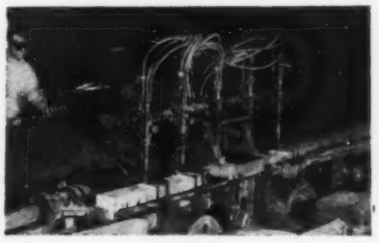


This sketch shows how a UNIONMELT butt weld is made.



UNIONMELT WELDING

UNIONMELT electric welding is a unique automatic process that makes welds of unusually high quality in any thickness of metal at high speeds. Once the speed and current values are established by the operator, the "human element" is eliminated as a factor in producing good welds. UNIONMELT welding is done under a protective blanket of a special granulated material—without flash, glare, or sparks. The rod is fed automatically as work progresses and is thoroughly mixed with the molten base metal. For these reasons, UNIONMELT welding is widely used in the fabrication of pressure vessels, pipe, railroad equipment, tankers, and ships.

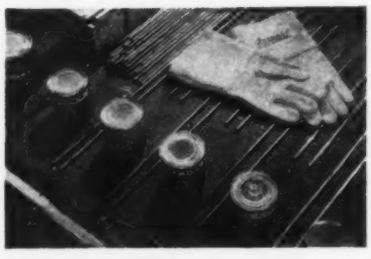


MACHINE APPARATUS

Included in the OXWELD line of apparatus are portable and stationary oxy-acetylene machines for cutting shapes or straight lines; flame-hardening apparatus; bar and billet cut-off machines; automatic welding equipment; and tractor units for plate-edge preparation.

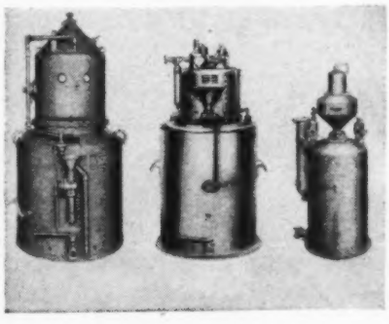
HAND APPARATUS

Oxy-acetylene apparatus which may be ordered from Linde includes oxy-acetylene blowpipes for all welding and heating work; oxy-acetylene cutting blowpipes, cutting attachments, and nozzles; and oxy-acetylene descaling and flame-priming equipment. OXWELD apparatus is supplied from Linde offices and warehouses. The PUROX and PREST-O-WELD line, and PREST-O-LITE air-acetylene appliances for soldering and brazing, are distributed by industrial and automotive jobbers.



WELDING RODS AND SUPPLIES

The many kinds and sizes of OXWELD high quality welding rods make it possible to select the one that will give best results on each job. The OXWELD line also includes fluxes, gloves, goggles, lighters, hose, and asbestos paper. Rods and supplies may be ordered from Linde or from automotive and industrial jobbers.



GENERATORS AND MANIFOLDS

OXWELD acetylene generators are made for both portable and stationary use — with maximum generating capacities of from 30 to 9,000 cu. ft. per hour. OXWELD manifolds centralize the oxygen and acetylene supply from cylinders.

OXYGEN, ACETYLENE, CARBIDE

A booklet describing use of LINDE oxygen, PREST-O-LITE acetylene, UNION carbide, and OXWELD apparatus in these and other processes will be sent without charge on request. Ask for Form 5268A.

BUY UNITED STATES WAR BONDS AND STAMPS

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

30 E. 42nd St., New York 17, N. Y. UCC Offices in Other Principal Cities

In Canada: Dominion Oxygen Company, Limited, Toronto

The words "Linde," "Prest-O-Lite," "Union," "Oxweld," "Purox," "Prest-O-Weld," "Haynes Stellite," and "Unionmelt" are trade-marks of Union Carbide and Carbon Corporation or its Units.

THIS air BREAKER'S A NATURAL

THE G-E "MAGNE-BLAST"

Here's proof of its milder action that protects your equipment

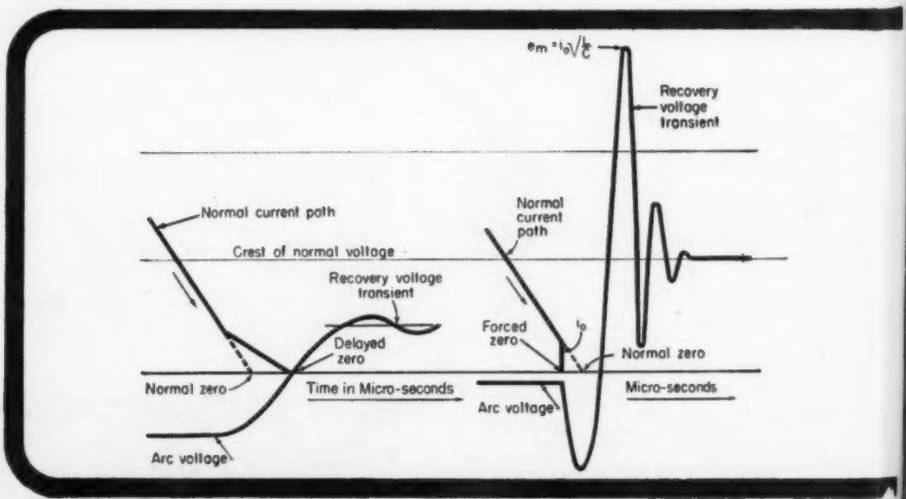
Metal-clad switchgear with magne-blast circuit breakers has been installed on typical arc furnaces for service up to 13,800 volts. Performance is outstanding, and no surges have been experienced in the interruption of magnetizing current. This type of breaker interrupts magnetizing currents in less than four cycles of arcing, at a normal zero or slightly delayed zero. A comparison of magne-blast interruption characteristics with oil-blast characteristics is shown in the graph.

Magne-blast breakers interrupt the circuit by magnetically forcing the arc into a labyrinth of insulating barriers. The barriers elongate the arc and absorb its heat. This increased resistance rapidly reduces the current and the phase angle of the circuit. At an early current zero, the arc path is so long, the voltage is so reduced, the gases produced by the arc are so cool that the arc cannot re-establish itself, and interruption occurs. This action is shown in the small drawings on the next page.

Metal-clad switchgear is shipped to you completely assembled—ready to install—with all the necessary associated equipment, such as instrument transformers, buses, and connections in separate, grounded, metal compartments. Because of its completeness and compactness, and the ease with which it can be installed, it provides the logical way to buy switching safety at low cost. *General Electric Company, Schenectady 5, N. Y.*

COMPLETE ELECTRIC EQUIPMENT FOR ARC FURNACES

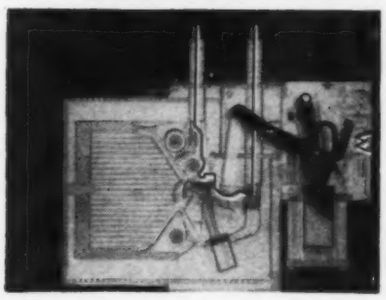
Buy all the BONDS you can—
and keep all you buy



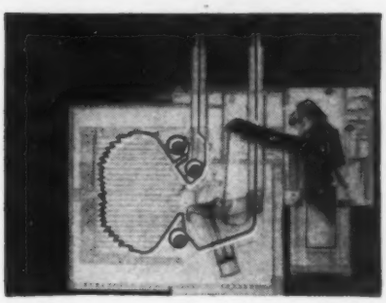
The magne-blast breaker's action is mild—no high surge of recovery voltage after current interruption.

An oil breaker's action on interruption of circuit is followed by high surge of recovery voltage.

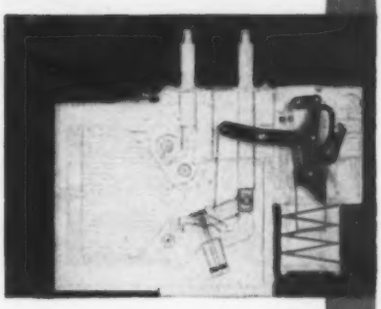
FOR ARC-FURNACE SERVICE



Breaker closed, trip coil energized. Red line shows electric circuit from stud to stud, through main, intermediate, and arcing contacts.



Circuit being interrupted. Red line shows path of current through three blowout coils as the arc is driven into the arc chute.



Circuit interrupted. Closing mechanism in reset position, and closing solenoid energized to reclose breaker.

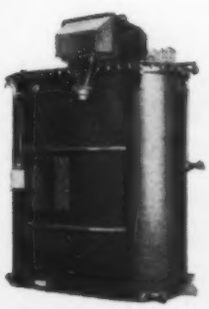
These husky breakers are easy to inspect

Magne-blast air-circuit breakers can be inspected quickly and safely. Simply lower the breaker onto the transfer truck; roll the truck and breaker out into the aisle where you have plenty of room to work; then

slide the enclosing case off, and the contacts are in full view. You don't have to wait for insulating liquid to drain before inspecting.

These co-ordinated units complete a top-performance installation . . . .

Amplidyne control provides a degree of accuracy and high-speed response that is equalled by no other type of control. Fast, smooth electrode operation, together with instantaneous corrective action, permits current to be maintained under changing furnace conditions. In addition, the unique amplidyne requires no continually operating contactors and relays and, therefore, requires comparatively little maintenance.



The G-E furnace transformer is specially designed with windings that are insulated and braced to withstand the severe service of arc-furnace loads. Wedge-type ratio adjusters, for selecting the desired furnace voltage, are interlocked with the main circuit breaker to prevent tap-changing under load. All connections inside the transformer are silver brazed for long service.

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An oil hydraulic system furnishes power for the hoisting and gripping cylinders. Contact rails located in a trench under the bridge, supply the operating electric current.

When confronted with handling problems, steel mill engineers have for 42 years consulted Alliance. In that time we have become known as "The World's Largest Builders of the World's Largest Cranes." We build equipment for handling any load, from the smallest ingot to a 300 ton ladle of molten steel.

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WEAN

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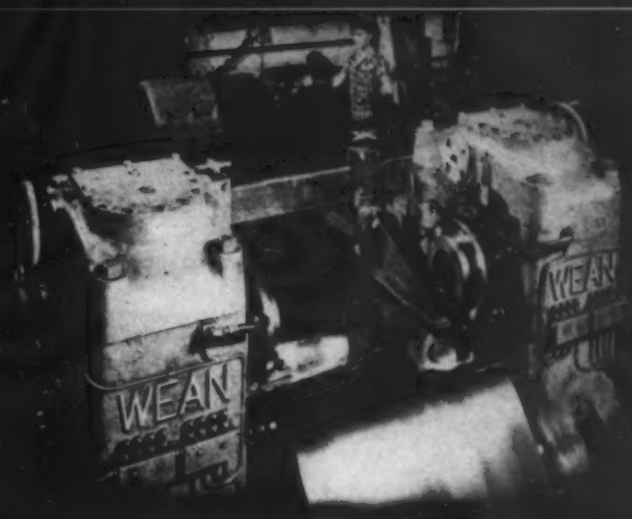

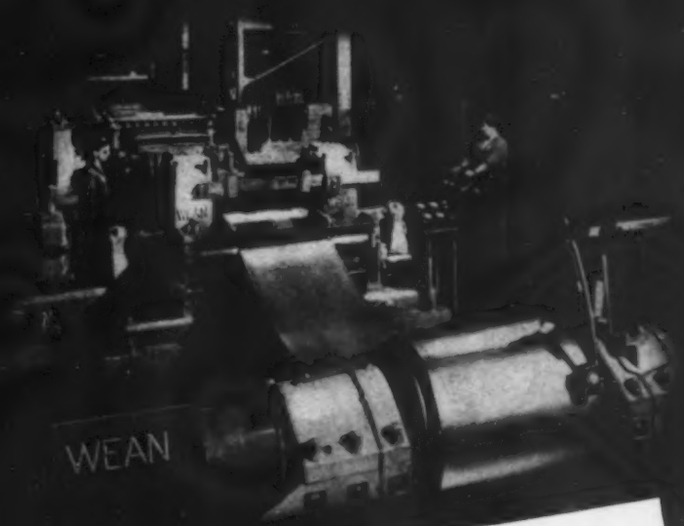

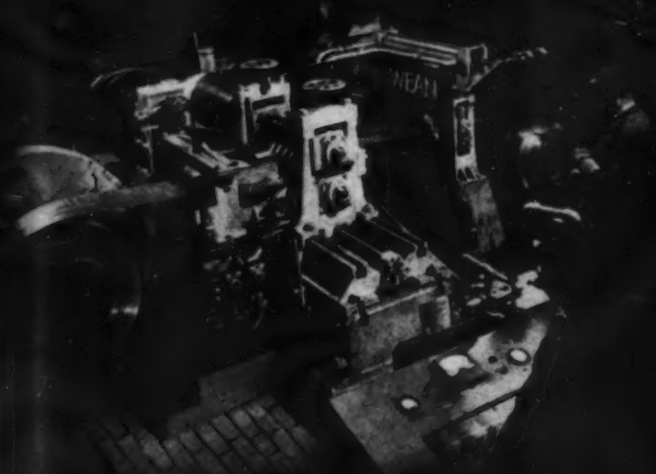

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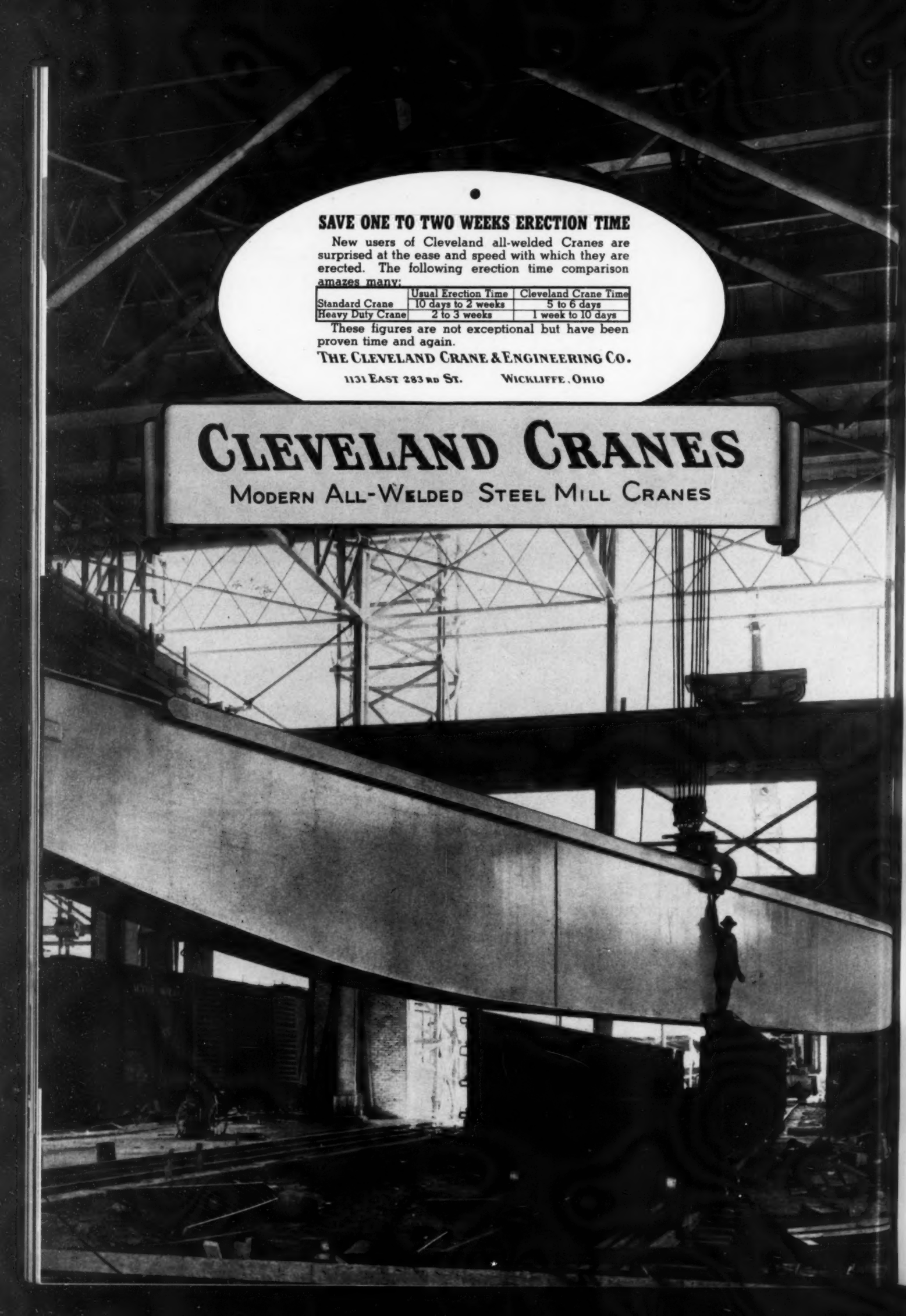
SAVE ONE TO TWO WEEKS ERECTION TIME
New users of Cleveland all-welded Cranes are surprised at the ease and speed with which they are erected. The following erection time comparison amazes many:
Usual Erection Time
Cleveland Crane Time
Standard Crane
10 days to 2 weeks
5 to 6 days
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1 week to 10 days
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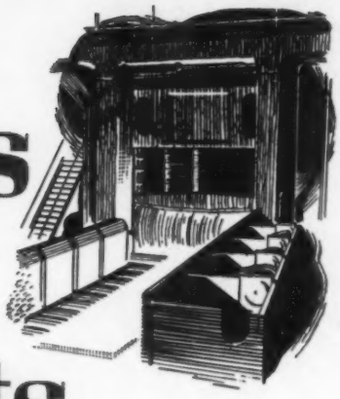
CLEVELAND CRANES
MODERN ALL-WELDED STEEL MILL CRANES

Crops and Shorts



WPB promises immediate removal of almost all controls over materials upon the surrender of Germany except those absolutely necessary to the reduced war production for finishing Japan. The board will maintain its organization and powers to insure an adequate war production program and to assist in resuming civilian production. Turning industry loose on their own will of course allow industry to be blamed if severe unemployment occurs, while the administration can still take credit for the move if the conversion is accomplished without undue unemployment.

▲

GENERAL predictions now call for a 40 per cent cut-back in war production at the end of the European phase of the war. This would give us, for civilian production, more steel than we used in 1939 — and over one-and-one-half times our copper consumption and over twice our aluminum consumption in that year.

▲

ACCORDING to a Bureau of Mines survey, six areas in the Alaskan Arctic slope show oil seepage, indicating the presence of oil. The territory includes approximately 100,000 square miles, almost uninhabited and subject to arctic weather.

▲

EVEN American politicians could take a lesson from some of the European countries who switch from shooting Allied troops to shooting Germans with unsurpassed facility and gusto. Such switches make one wonder whether these countries are really looking for liberation or merely a winner.

▲

COKE production in 1943 (byproduct and beehive) totaled 71,676,063 tons, a two per cent increase over the record output of 1942. Of the total, 89 per cent was byproduct and 11 per cent beehive. Beehive coke decreased but was more than offset by increased production from byproduct ovens. Coal used in coke production totaled 102,460,000 tons. Byproduct practice showed an average coke yield of 70.81 per cent, with byproduct recoveries of 8.11 gallons of tar, 20.32 pounds of ammonium sulphate (or equivalent) and 10,680 cubic feet of gas per ton of coal charged. Surplus gas used or sold averaged 6,590 cubic feet per ton of coal.

▲

DURING 1943, 953 new byproduct coke ovens (with an annual coke capacity of 5,220,610 tons) were completed. At the end of the year 14,253 byproduct ovens were in existence, with an annual capacity of 71,378,408 tons of coke. There were also 528 byproduct ovens under construction. At the same time, beehive ovens totaled 17,666 with a capacity of 11,230,396 tons of coke per year. Blast furnace use totaled 57,690,160 tons for the year.

▲

L. R. MACGREGOR, director general of war procurement supplies for Australia, while recently inspecting Pittsburgh plants of Carnegie-Illinois Steel Corporation, set lend-lease from the United States to Australia at 6,000,000 tons of material worth about $1,250,000,000, with reverse lend-lease probably totaling almost as much. Likewise, he said, girls lost as brides to soldiers now stationed in Australia will probably be offset by brides brought back from other countries by Australian soldiers.

▲

IN June, almost every item of war production was below previous peak production months. Much of this was due to cut-backs although manpower was also a contributory factor.

August plane production was 7939, 3.5 per cent below the scheduled figure. Cut-backs are already set for the last months of this year and for 1945.

▲

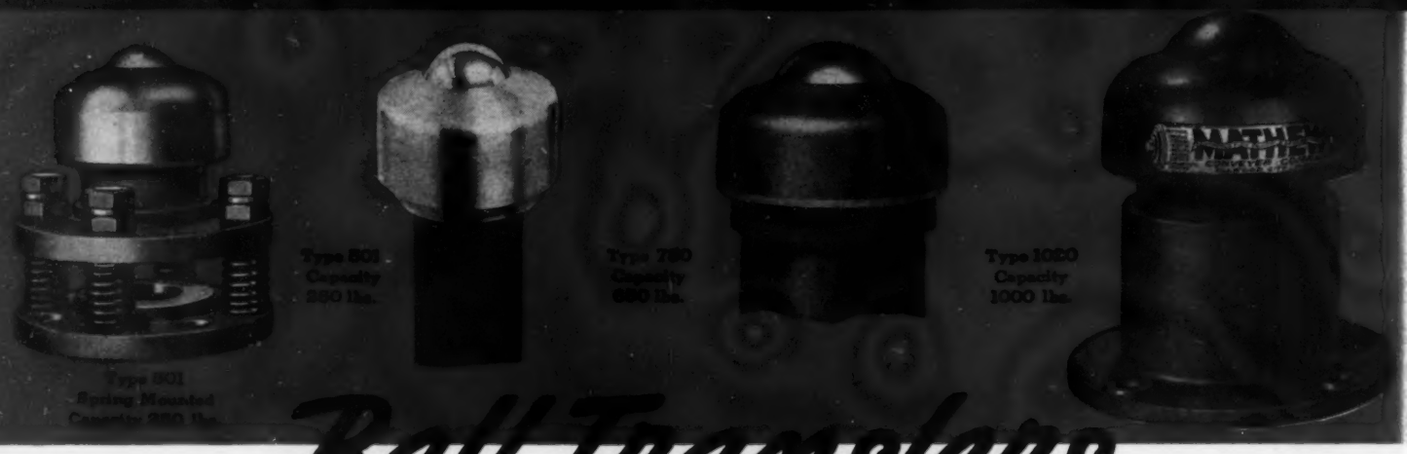
IF the newspapers persist in publishing these photographs of our soldiers being hugged and kissed by French lassies, we can look for our divorce rate to go up — or at least our postwar injury record.

▲

IRON ore production during the first seven months of this year totals 53,087,924 tons compared with 52,727,213 tons for the same period of 1943. Even better is the ore transportation situation which shows shipments from mines for seven months of this year to be 52,934,380 tons compared with 49,736,332 tons last year.

▲

BITUMINOUS coal production this year is running about 7 per cent above that of 1943. Thanks mainly to four general mine stoppages by strikes last year. (A few more foremen's strikes should bring us into line). Coking coal, however, has tightened to such an extent that the Solid Fuels Administration is diverting coal of coking quality from steam generation use to the coke plants. Coal inventories in many coke plants are down to a two-weeks supply or less, a dangerously low figure.



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Iron and Steel ENGINEER

SEPTEMBER 1944 VOL. XXI NO. IX

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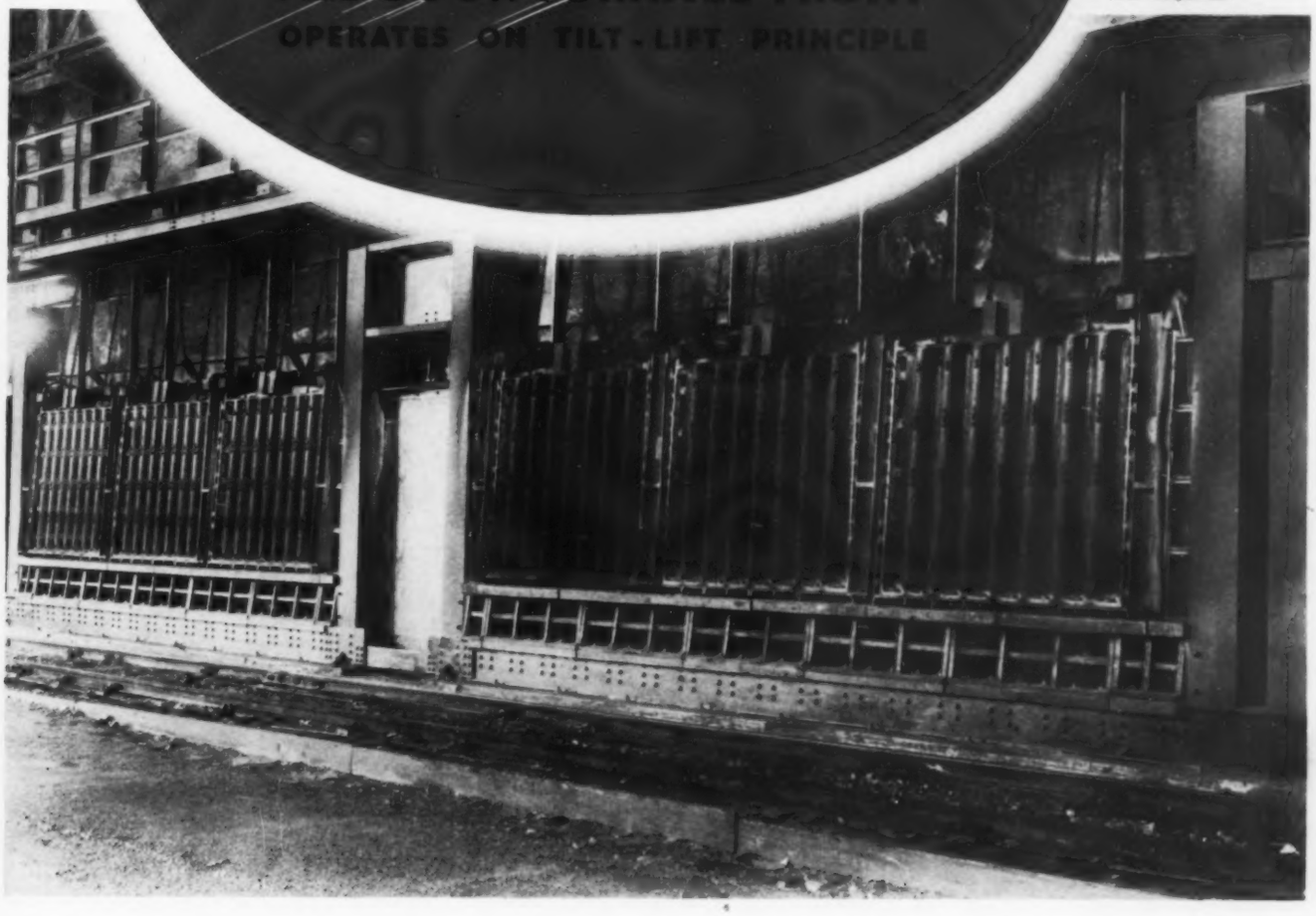

Front view of one of these plate mill furnaces of a two chamber design, each chamber equipped with 3 consecutive doors which enclose a 21' 0" unobstructed charging opening. Photo by courtesy of The Carnegie-Illinois Steel Corporation

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Steel Plant MAINTENANCE

. . . . maintenance problems in war-time differ from those of prewar days . . . . post-war maintenance will benefit from some of the methods forced upon us by present necessity. . . .

by A. G. Henry, MAINTENANCE SUPERINTENDENT

TENNESSEE COAL, IRON AND RAILROAD CO.

FAIRFIELD, ALABAMA

▲ THIS paper is presented in an effort to bring out the differences between maintenance problems before the war and those we face at present, concluding with a brief glance into the future when return to normalcy begins.

Before the war, as at present, preventive maintenance was the best insurance for a low maintenance cost. Preventive maintenance is a systematic effort, by inspection at frequent intervals of the equipment involved in the production of plant products, to make replacements or repairs before actual failures occur. By adherence to this method of preventive maintenance a great deal can be accomplished in reducing costly mill delays. This, together with a scheduled lubrication program involving the correct lubricants in the correct amount applied on a definite schedule, is the basis on which a good maintenance program is conducted.

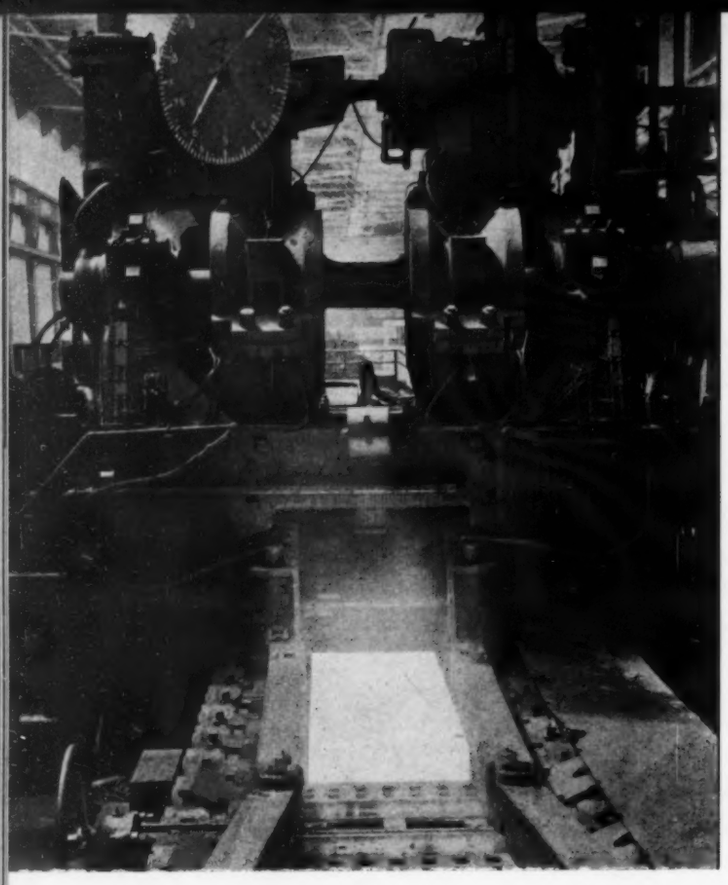
Before the war it was comparatively easy to obtain the right materials and parts to assure continuous operation of equipment. If a bearing or any other piece of equipment was lost, replacements were obtained quickly and the repairs made. Repair work could readily be planned in advance of a great majority of failures or anticipated failures. We had organizations of trained employes with years of experience and a minimum amount of personnel turnover. Suitable alloys could be obtained for parts involved and to meet conditions as they occurred. There was a competitive spirit among the manufacturers whose products were used. Briefly, the best to be obtained to help solve the problem was readily available. That period of time seems a long time ago.

Then came the war. At first the changes and restrictions did not affect operations to a great extent, but after several months it was realized that to keep rolling it was going to be necessary to be extremely resourceful. It is still the proper policy to carry out a preventive maintenance program, but it has been discovered that due to restrictions on critical material numerous substitutions must be made. Parts that at one time were scrapped because it was not economical to continue them in service are now often "doctored up" and kept in use.

On numerous occasions it has been necessary to alter equipment to suit available bearings. In one piece of equipment at our tin mill there are three different sized bearings, where previously one size sufficed and was readily available. This brings out a point that I believe should be stressed. Due to numerous necessary changes that are now being made, it is very important to keep the engineering departments well posted so that drawings can be kept up-to-date. If this is not done, an operator is cultivating a lot of headaches for the future.

Maintenance departments, like all other departments, have lost a large number of employes to the armed forces. To replace these men we have done a lot of shuffling in an endeavor to get the right man in the right place. In addition, we have set up a school for training machine operators. During the past year, we have trained approximately forty-five girls, and the results have been very gratifying. Each trainee in our school is required to work an eighteen-week training period, and during this period the trainee is instructed

Presented before A. I. S. E. Birmingham District Section Meeting, January 31, 1944.



A great amount of lost time was avoided by repairing the foundation of this universal mill by inserting a slab under the bearing housing and running in a low grade babbitt after the equipment was shimmed up to the correct elevation.

in the operation of lathe, milling machine, shaper, drill press, power saw and bench work. This group, while in training, is engaged in making parts for maintenance use. After completion of the training period the girls are placed in the machine shop and good results are being obtained from the work assigned to them. In fact, the results have far exceeded expectations.

We have a large fleet of tractors, the majority of which are now operated by girls, and it is pleasing to note that maintenance and up-keep on these units have decreased to an appreciable degree since the girl operators took over.

A salvage campaign to recover used bolts, nuts, pipefittings and valves has been established. Used bolts and nuts are taken to one location, reconditioned and sorted as to sizes. Used pipefittings and valves are inspected, reconditioned, tested and graded as to size and type, and are then tagged with the information as to what they can be used for. In some instances, parts are required from several valves to make one valve suitable for further use.

We all have our problems in these times and possibly by discussing some of those which we have had to solve, we may be of some assistance to each other. One of the jobs required in the tin mill machine shop today is the reconditioning of shell forging tips (a war baby). Originally these tips were turned and polished on lathes. Having a limited capacity of machine tools, this reconditioning work tied up more equipment than could be spared. To overcome this condition, a polishing and buffing machine was built. The lathes are now used for turning the tips only. Tips are transferred to the polishing machine for finishing. This has enabled us to recondition the quota of tips agreed to and has released the lathes for other work.

A good example of the quality of some materials available today as compared to pre-war material is in connection with our slab reheating furnaces. A furnace bottom rebuilt today has an average life of only about thirty per cent of its pre-war life. While talking about furnaces it should be interesting to relate the following incident that occurred some time ago. Normally, our slab furnaces operate on coke oven gas. However, the installation is so arranged that, if for any reason there is a shortage of coke oven gas, natural gas can be used. Coke oven gas leaves a tar deposit in the piping system and the valves used in controlling gas flow. Several months ago it was necessary to switch from coke oven to natural gas. While the furnaces were on natural gas it was decided that necessary repairs should be made on No. 1 slab furnace. Valves to this furnace were closed and tagged to prevent opening. After a cooling off period, workmen were engaged in making repairs inside the furnace. During these repairs one of the workmen lit a burning torch and from this torch one of the furnace burners ignited. This could have resulted in a serious accident, possibly a bad explosion. Although the gas valves had been shut off sufficiently to let the burner go out, the tar residue under the valve seats permitted gas to leak through to the burners. Now, regardless of whether coke oven or natural gas is being used for fuel on these furnaces, valves alone are not depended upon. The gas line going to the furnace to be repaired is blanked off.

A problem for which an immediate solution had to be found was the failure of the tilting table foundation on the 42 in. universal mill. After careful analysis of what would be necessary to put this equipment in a satisfactory condition for continued operation without a shut-down period of approximately one week to ten days required to strip equipment from foundations, remove broken foundation, install new foundation and replace equipment, it was decided that repairs could be made in forty hours that would carry us over for the duration of the war. This was accomplished in the following manner: The tilting mechanism was removed. Loose parts of the broken foundation were removed and what was left of the old foundation was thoroughly cleaned. Equipment was reinstalled and shimmed on flat steel shims to the correct elevation and line. Forms were placed around the foundation and low grade babbit was run in. In addition, a 12,000 lb slab was securely fastened at the base of the bearing housing. This has solved our problem and should remain in a satisfactory condition until such time that a regular concrete foundation can be installed. When this takes place the babbit and slab used in this emergency repair will be recovered.

We are all familiar with the rubber problem, particularly in reference to tires for our cars, but an item of rubber that weighs approximately 1–10 oz was the source of considerable trouble on our finishing stands. On the roll balance hydraulic system the connections to the roll jacks are made with a patented coupling, the use of which speeds up roll changes. These couplings have a washer made of natural rubber before the restrictions on rubber were introduced. When these washers were placed on the list of items no longer to be made

from natural rubber, it was necessary to use a substitute made from reclaimed rubber. While using this substitute, replacements of these washers were about ten times as great as before. It required one man's time to make necessary replacements. We have washers now made of synthetic rubber that are at least the equal of the original natural rubber washers. Needless to say, this was an instance where a small item caused a lot of trouble.

Some months ago there was installed on our cold reduction tandem mill a new type spray which has produced excellent results. This spray can be cleaned in approximately two minutes, whereas the conventional spray formerly used required several hours to clean. The new spray header is in two sections. These sections are bolted together. The spray jets are cut in the split between the two sections, simplifying the cleaning problem. The old type sprays were individual sprays joined to a one-piece header by lengths of pipe that made it necessary to use drifts to clean them. The new spray has also assured a more equal spread of coolant on the strip being rolled.

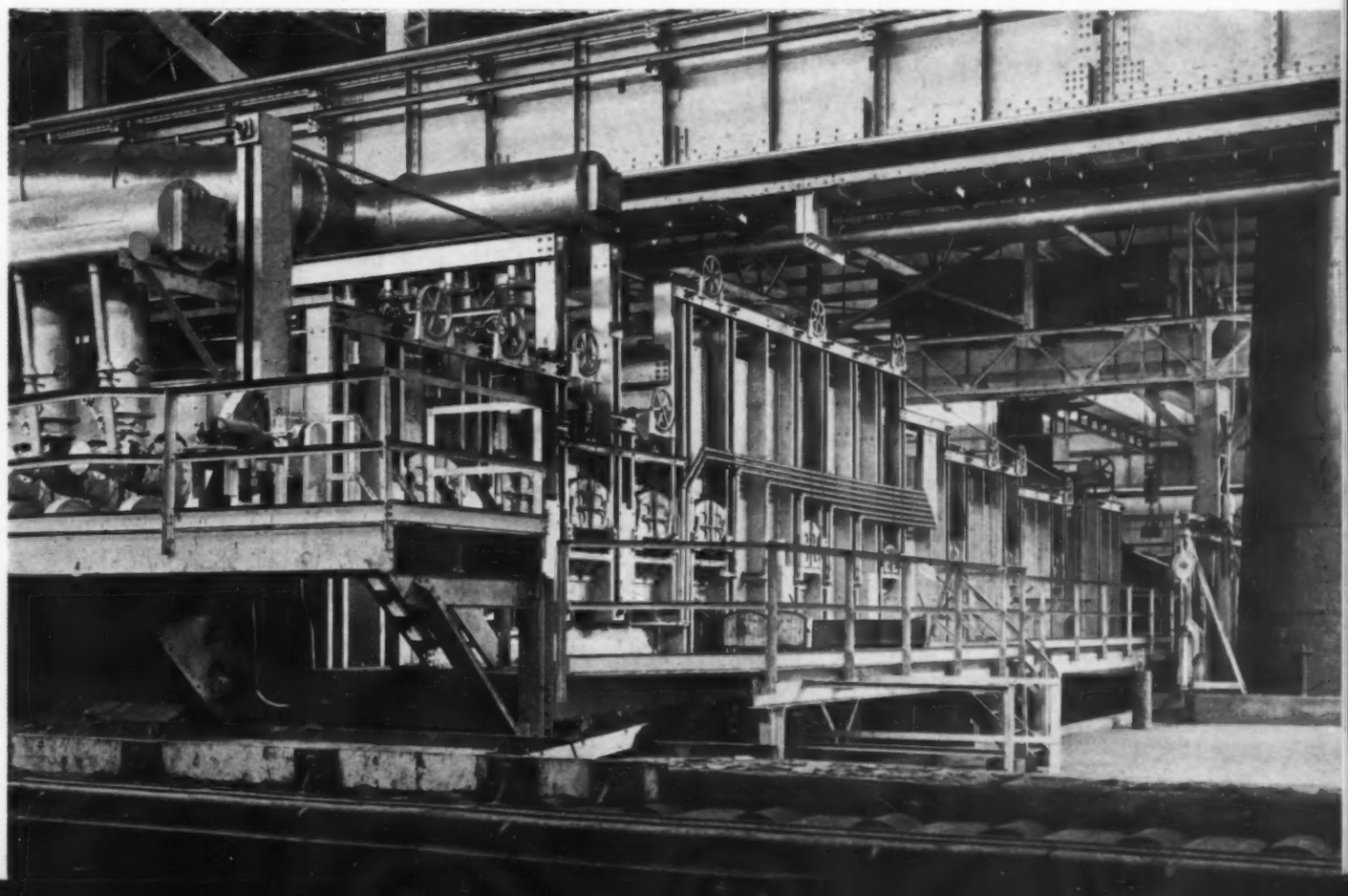
Our electrolytic cleaning lines originally were equipped with rubber rolls. To a great extent these have been replaced with alloy rolls. This has not only resulted in a maintenance saving, but has materially contributed to the conservation of vital rubber.

The prevention of grease and soluble oil from getting on the strip at the temper mills and shears has always been a major problem. Since the installation and operation of the electrolytic tinning lines, this problem has been more acute than before. Close fitting guards, closer attention to roll bearing seals and roll jack upkeep, and control of oil pressure to minimum requirements, along with cleanliness of equipment, have helped correct a considerable amount of the trouble we experienced. However, this is a condition that calls for the continued vigilance of all concerned.

The various feeders at the hot dip tinning units are equipped with brass rolls. These rolls are constructed from brass tubing. At intervals the rolls were ground and polished and when they had been reduced to a minimum size they were scrapped and new tubing applied. Now we metallize these rolls, spraying on sufficient metal to restore them to original size. This method of recovery has reduced our roll cost on these units and has materially contributed to the conservation of brass.

It is also gratifying to know that through close cooperation with the operating department heads and the engineering and metallurgical departments, problems which seemed almost insurmountable have not proved so difficult from a maintenance viewpoint. Many lessons are being learned by all of us during the emergency. But we should all profit immensely from our present handicaps. After eliminating some of the impractical methods brought about by necessity, many new ideas will remain as bonuses for our trouble. Processes which have stood the critical tests of wartime peak production are certain to be serviceable for normal peacetime manufacture.

A comparison between materials available today and pre-war materials is offered in the case of slab heating furnace bottoms, which now have an average life of only 30 per cent of pre-war experience.



Maintenance Symposium

by L. R. Robinson

PRESIDENT

PITTSBURGH PIPE CLEANER COMPANY

PITTSBURGH, PENNSYLVANIA

by W. J. McGregor

STEAM EFFICIENCY AND COMBUSTION DEPARTMENT

JONES AND LAUGHLIN STEEL CORP.

PITTSBURGH, PENNSYLVANIA

by H. D. Stanley, ENGINEER

STORAGE BATTERY DIVISION

PHILCO CORPORATION

TRENTON, NEW JERSEY

by H. L. Coe

ASSISTANT SUPERINTENDENT OF MAINTENANCE

CARNEGIE-ILLINOIS STEEL CORPORATION

CLAIRTON, PENNSYLVANIA

Pipe Cleaning

by L. R. Robinson

▲ THE cleaning of pipe has become very important at the present time, due to the shortage of materials which may be required for replacement of pipe, and also due to the shortage of man power for making such replacement. Pipe cleaning can be sub-divided into several groups or classifications, as follows:

1. Blast furnace hearth jacket cooling pipe.
2. Boiler tube cleaning.
3. New pipe cleaning.
4. Condenser or heat exchanger tube cleaning.
5. Chemical lines.
6. Water lines.
7. Sewers and drain lines.
8. Gas lines.

The object of cleaning any pipe or sewer is primarily to increase the flow of the liquid or gas through the pipe or conduit. The method employed for cleaning pipe depends entirely upon the size of the pipe and the nature of the deposit.

Presented before A. I. S. E. Pittsburgh District Section Meeting, April 10, 1944.

It has been found practical to clean pipe or tubes as small as ⅛ in. inside diameter with a mechanical apparatus consisting of a flexible cable constructed of helical wound spring steel with some sort of reinforcement to insure sufficient strength to withstand the torsion applied and yet allow for flexibility, so that this cable can be driven through bends and through coils. It is necessary to use a mechanically driven machine with hollow shaft having a clutch mechanism for engaging and disengaging the cable which is being used for such cleaning purposes. These mechanical machines can be operated by electric motor or other type of power, such as gasoline engine, air motor, steam turbine or water turbine, as may be required. The limitation of using such apparatus depends upon the speed at which the cable is driven, the size of the pipe to be cleaned and the size of flexible shaft that can be revolved at a speed which may be required for breaking up, cutting, or brushing the deposit from the pipe. It is necessary, as the pipe increases in size, to increase the diameter of the flexible cable or driven shaft, so that more power can be applied and also to prevent the

cable from turning back in the pipe, which may cause the cable to break or twist or become looped or fouled in some manner which may prevent its rotation. It has been found that it is not advisable to use cutting tools which might be large enough to fit the pipe tightly; there must be considerable clearance between the tool and the inside of the pipe so as to prevent jamming or sticking when such tool is being driven by a flexible cable.

By using a cable approximately 1 in. in diameter and helically wound, it is practical to clean pipe up to 12 in. inside diameter as much as 300-350 ft from one opening.

BLAST FURNACE HEARTH JACKETS

When cleaning bent tubes such as the cooling tubes used in hearth jackets of blast furnaces, it is necessary to use a reinforced cable constructed with an inner core and spring steel helically wound over this inner core. The type of tool for cleaning hearth jacket cooling coils must be determined from the construction of the cooling pipe or coils, particularly the manner in which the tool and cable must be inserted into these coils. Some of these pipe fittings in hearth jacket plates are bent at a 45 degree angle or come out at a 90 degree angle, where they come out of the plates for the water connection. Sometimes when these pipe are bent flat spots are encountered at the bends, and this means using a smaller tool than can be used where the pipe is more nearly round at the bends, or where the connections come straight up out of the jackets.

The nature of the deposit encountered in blast furnace hearth jackets will vary considerably with the nature of the water used for cooling. Due to this variation in deposit, the type of tool used for cleaning will vary. When a completely blocked tube or coil is encountered in the hearth jacket, it is advisable to insert a small pipe into the hearth jacket coil and force water down into the coil to the obstruction. This should be done on each side of the obstruction, so as to prevent additional hardening or baking of the deposit causing the obstruction. When these obstructions are encountered, it is invariably necessary to use a cutter with a blunt end having cutting notches in it, similar to a typical end mill cutter. For passing around small 90 degree elbows or flat spots, it is necessary to use an offset cutter which is made with an irregular shape so as to allow this cutter to pass through the pipe and to be withdrawn when removing the cable and tool.

BOILER TUBES

For cleaning tubes in water tube boilers, it has been found that a flexible cable properly reinforced as herein stated can be passed through a mechanical machine with a hollow type shaft and rotated at a relatively high speed, so that it can be driven around tubes having U-turns or 90 degree bends. The type of tool necessary for cutting the deposit will depend upon the consistency and thickness of the deposit. When hardened scale is encountered, it is invariably necessary to use a heavy tool with an eccentric action, so as to chip the deposit from the inside of the tube. When softer deposits are encountered, or for finishing a tube after removing a hard deposit, a cutter with expanding blades mounted in a suitable head can be attached to the cable and rotated back and forth through the tubes, so as to insure a clean smooth tube.

NEW PIPE

New pipe should be cleaned before it is installed in boiler settings, hydraulic systems, lubricating systems, cooling systems, etc., in order to remove mill scale, welding beads, sand, etc. This may be done by using a suitable cutter, brush or scraper attached to a flexible cable in the same manner as may be used for cleaning boiler tubes.

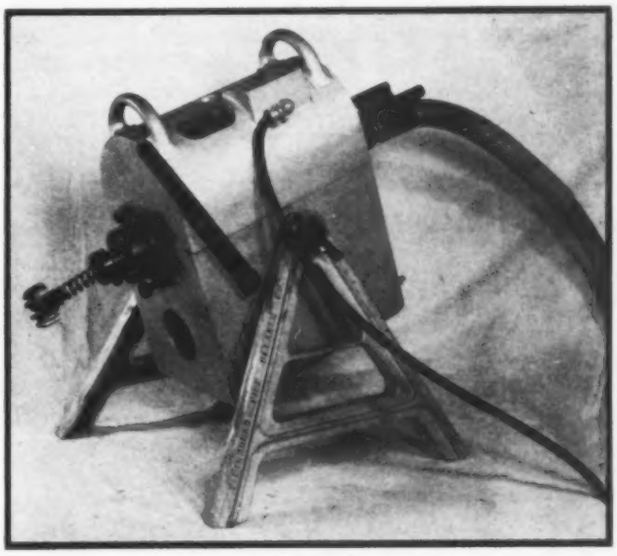
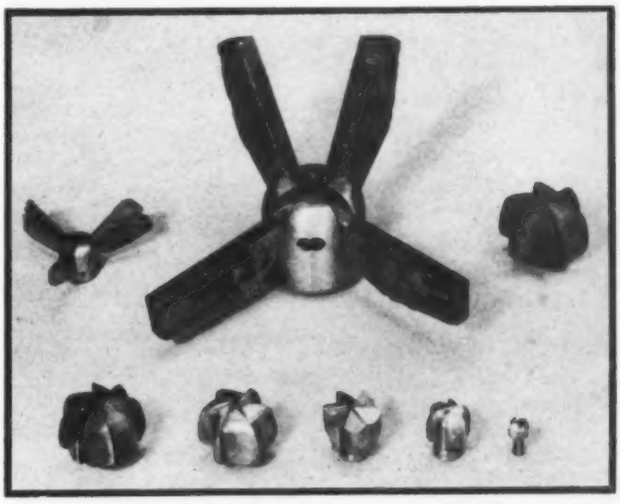


Figure 1 — One type of mechanical pipe cleaning machine, capable of cleaning lengths of 200-300 ft of pipe ½ in. to 12 in. in diameter.

▲

Figure 2 — Various types of cutter tools are used on the mechanical pipe cleaning machine.



CONDENSER OR HEAT EXCHANGER TUBES

Condenser or heat exchanger tubes will vary in size and construction according to the designer's ideas. When straight tubes are encountered, it is necessary to use a tool which will remove the scale without injury to the tube. A long hair pin type cutter constructed to suit the diameter of the tube with opposite cutting edges is found to be suitable for most condenser tubes of the straight type. Heat exchangers with the U-turn construction can be successfully cleaned with a round nose tool, sometimes called a "ball nose" tool, and can be driven by means of a flexible cable around the U-bends. On tubes larger than 1 in. inside diameter, an expanding cutter with blades which fly out due to the centrifugal action, can be used for removing very hard scale. Since most of the tubes used in condensers, boilers, or heat exchangers are not more than 25 ft long, it is more practical to use a flexible cable of one piece construction, allowing only such additional length as may be necessary for driving from the mechanical machine.

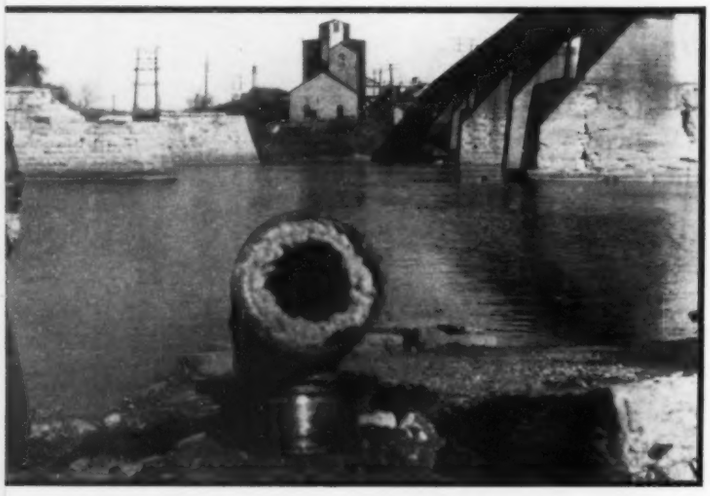


Figure 3 — An 8 in. water main in the Chicago district, showing deposit before cleaning.

▲

Figure 4 — This 12 in. water main was cleaned for a railroad in the midwest.

CHEMICAL LINES

In cleaning chemical lines the progress of work will vary considerably. Some deposits are extremely hard and require higher speed for small lines than is usually required for boiler tubes or water lines, etc. When the deposit is not more than the thickness of the pipe, it very often can be removed with a flexible cable with tool attached which will allow for the hammering action. As this deposit increases in thickness, more time is required for removing it, and it is very often necessary to use a tool with a drilling action.

WATER LINE CLEANING

Water lines from 4 in. to 48 in. diameter can nearly always be cleaned by what is known as the hydraulic method. The hydraulic machine used for this work is constructed with flat spring steel bars, fixed to a leading head and an arrangement made for adjusting the tension desired. On the rear of these flat spring bars are attached cutters or plows curved to suit the inside diameter of the pipe which is to be cleaned, so that the cutter must come in contact with all parts of the pipe. The tension required on the springs for pressing the cutters against the inside of the pipe will be determined by the nature of the deposit in the pipe. The harder the deposit, the greater the tension. As a rule, most water lines can be cleaned by forcing the hydraulic cleaner through the pipe only once. These hydraulic cleaners are forced through the pipe by means of conical cups which are mounted in back of the cutters. The pressure of the water against the cups will produce an impact equivalent to the amount of pressure which may be either due to gravity or to the action of a pump. The area of the pipe and the unit pressure determine the total impact applied to the cleaner. The speed of cleaning varies from 10 fpm to as much as 300 fpm, depending upon the hardness of the deposit being removed, the volume of water used and the amount of pressure applied — the larger the line, the less pressure per square inch; the smaller the line, the greater the pressure per square inch.

The results of cleaning water lines can best be determined by actually measuring the flow of water and the pressure required for producing such flow. As an illustration, a large railroad is using a 6 in. cast iron class D bell and spigot lead joint pipe 7412 ft long, from a pump up into a storage tank. The static pressure at the pump, with the tank full of water and the valves shut off at the pump is 44 psi. Before cleaning, the volume of water pumped was 8000 gallons per hour or 134 gallons per minute. The total static pressure was 75 psi. The static pressure due to friction was therefore 31 psi. It was desired to pump 350 gallons per minute through this pipe. There was available a triplex pump with a 15 hp drive geared at a speed of 54 rpm on the pump, capable of producing 350 gallons of water per minute. When attempting to operate this pump, the pressure increased to 156 psi and the motor was instantly overloaded and would not drive the pump.

This line was cleaned by the hydraulic method and

by means of a mechanical machine. Because of the presence of four 90 degree elbows in the first 100 ft of pipe from the pump out, it was found to be quicker to clean from this point back to the pump with the flexible steel cable and a double spade cutting tool constructed of steel with sharpened edges, operated by an electrically driven machine. When the pipe was opened there was only a 2½ in. opening through the deposit in the pipe. The line was again cut 2800 ft from the pump and the hydraulic cleaner driven through this length of pipe. The hydraulic cleaner was then inserted in the next length of pipe which was cut

Figure 5 — A piece of the deposit found in an 8 in. sludge line in a Pennsylvania steel plant.

2400 ft from this point and the cleaner was driven through this section. The pipe was again cut at the tank and the hydraulic cleaner inserted in the last length of pipe, which was approximately 2200 ft long, and the hydraulic cleaner was then driven through to the end.

Dresser couplings were used for reconnecting the pipe at the points where they were cut. After cleaning this pipe, triplex pump was put into service and produced 21,000 gallons of water per hour or 350 gallons of water per minute, at a total static pressure of 76 psi. The static pressure due to elevation still remained at 44 psi and the electric motor was using only 38 amperes with 220 volt, 3 phase current. The input power to the motor was slightly less than the rated 15 hp.

The theoretical friction loss for 350 gpm for 100 ft of 6 in. clean cast iron pipe is 0.50 psi. Passing 350 gpm through 7412 ft of 6 in. pipe, the friction loss should be 74.12 x 0.50, or 36.06 psi. You will note that the actual friction loss on this pipe was found to be only 32 psi. The power saving alone on this installation will amount to approximately $250 per month.

Quite recently a 12 in. water line in a large railroad yard in the middle west was cleaned for a distance of 4600 ft in 21 minutes actual cleaning time. This railroad company had been using a pump having a 100 hp drive and a capacity of 1250 gpm at 100 psi pressure to supply their storage tanks for filling steam locomotive tanks. After this line was cleaned, a 60 hp pump is now being used for supplying this water. This pump is supplying 1250 gpm at 76 psi pressure. The 100 hp pump will now supply 1850 gpm at 93 psi pressure. A

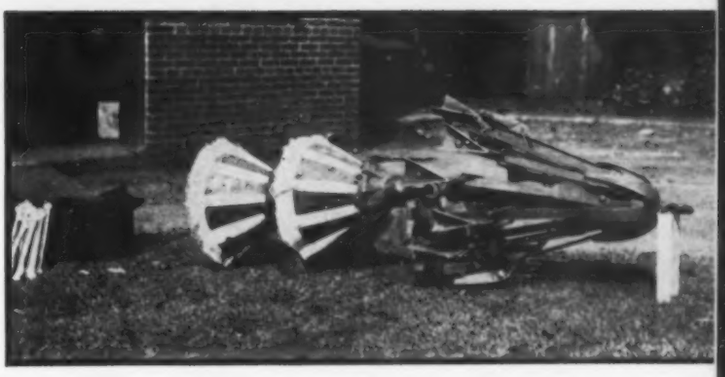


Figure 6 — A 16 in. hydraulic cleaner, driven through the pipe line by water pressure.

shovel, removed from this line while cleaning it, was probably the cause of a large part of the friction loss encountered before cleaning.

Gas lines can be cleaned by the hydraulic method, using water to force the hydraulic cleaner through the lines. Where heavy tar deposits are encountered, and sometimes where heavy deposits of flue dust or ore dust occur, it may be necessary to make two or three runs through the line, each time increasing the tension of the springs so as to shear the deposit from the inside of the pipe. Recently about 25,000 ft of 8 in. and 10 in. gas main was cleaned in northern Indiana, and in addition to the tar and carbon deposits removed, loose pieces of lead pipe which were used for drip blow-offs were removed ahead of the cleaner. On one run made on this line, four barrel staves, an old pair of shoes and a dinner bucket were removed.

SEWER CLEANING

Sewers with trap construction or with 90 degree bends ranging in size from 1½ in. to 12 in. can usually be cleaned quicker with a mechanical machine using a flexible cable and a cutting tool suitable for the deposit. Sanitary sewers which contain mostly grease or obstructions from foreign material such as oily waste, rags, pieces of cloth, shoes, etc. can very often be cleaned by means of an expanding helically wound cone shaped coil, used as a lead on the helically wound flexible spring steel cable. Relatively slow speeds are advised for this work, particularly for grease lines and when roots of trees are encountered.

Where large sewers are to be cleaned it is much quicker to use wire rope cable threaded through the line and attached to a winch at each end or, where possible, to a double drum winch at one end. Where hard deposits are encountered, it is nearly always necessary to use a slicing tool which will break up the deposit so that it can be removed by means of scoops or buckets. It is advisable in most cases to use buckets and lift the debris up out of the sewers so that it can be disposed of without washing the debris through to some other sewer. This is accomplished by using a wide sheave pulley properly anchored down in the sewer, usually at a man hole, so that the bucket can ride over the sheave and be drawn up to the pulley on an A-frame at the

surface. The bucket can then be pulled to one side and the deposit dumped out of the bucket on the surface. This same method can be applied for large water intakes where silt and other foreign objects may have gotten into the conduit from floods or high water.

In closing we might state that all types of pipe construction, regardless of whether it is steel, cast iron, copper, galvanized, wood-lined, rubber-lined, or plastic pipe, will accumulate deposits, depending upon the chemical found in the fluid passing through such lines. It is generally found that high pressure lines have harder deposits. The construction of the line will determine the amount of pressure that can be applied when cleaning hydraulically, or the type of equipment that must be used for removing the deposits.

Industrial Battery Maintenance

by H. D. Stanley

▲ A STORAGE battery, contrary to the usual conception, does not store electrical energy. Actually it stores chemical energy which is converted into electrical energy during discharge. On subsequent recharging the electrical energy supplied to the battery is spent in changing the active materials back to their original state, thus restoring the chemical energy necessary for another discharge. These changes of energy are made possible by the mechanical and electrical design of the cell.

About 85 years ago a scientist named Plante discovered and developed what has turned out to be the basic action involved in the functioning of lead-acid storage batteries. The cells he built consisted essentially of two lead strips separated from one another and immersed in a solution of sulphuric acid. The active materials necessary to produce current were formed on the surface of these strips by passing a current through the cell from an external source. The Plante and Manchester plate cells of today are direct descendents of these lead strip experiments.

Approximately 20 years later another scientist, Faure by name, developed a process for pasting the surface of lead plates with lead compounds which could be converted into active materials and pasted-plate batteries of today, which are by far the most generally used, are the result of development of his principle. Pasted plate cells have the advantage of a tremendous increase in capacity per unit of weight.

FUNDAMENTALS OF OPERATION

Let us now consider what actually takes place in a storage battery during discharge and charge. In a fully charged cell we have a positive and a negative electrode, mechanically insulated from one another, immersed in electrolyte. The active materials of the electrodes are lead peroxide for the positive and sponge lead for the negative. The electrolyte is a dilute solution of sulphuric acid varying in gravity from 1.200 to 1.280 depending on the type of service for which the cell is built. When fully charged, this combination has a voltage of approximately 2.0 volts on open circuit and from 2.12 to 2.70 volts while charging current is still flowing.

During discharge both the lead peroxide and the sponge lead combine with the sulphuric acid to form lead sulphate on both plates. This explains the two changes noticed, i. e., the decreases in voltage and in electrolyte gravity since:

1. The two elements approach the same chemical composition, thus decreasing the potential difference between them.
2. Sulphuric acid is removed from the electrolyte which consequently approaches water having a gravity of 1.000.

When a charging current is fed back into a discharged cell, these reactions are reversed. The lead sulphate is broken up, the active materials being reproduced in the plates and the sulphuric acid being returned to the electrolyte. Naturally, then, the voltage rises since the two elements are continuously becoming farther apart in composition and the electrolyte gravity increases as more and more acid returns to solution.

DEVELOPMENT OF PRESENT DAY TYPES

The present day storage battery is the result of continuous development and research since the discovery of its basic principles. The amount of power per unit of weight and the service life which can confidently be predicted even under severe operating conditions are excellent yard sticks by which to measure the progress that has been made.

Many improvements have come as a result of changes in mechanical design and manufacturing methods. Others have resulted from painstaking research in the laboratory. Raw materials, such as oxides and grid alloys, have been developed and improved by co-operation with suppliers. Some of these developments will be of interest.

GRID DESIGN

Grid design is of fundamental importance. For motive power service we are interested only in pasted-plate batteries. Grids for these batteries are of three

general types, straight bar grids, the so-called "ironclad" construction, and a radical modification of the bar grid introduced approximately seven years ago.

A typical bar grid has fairly heavy vertical through members thus breaking the plate into a number of parallel columns. These columns are in turn broken up by staggered light horizontal members. These latter members are usually less than half the thickness of the grid in height, thereby producing a continuous vertical ribbon of material to which each individual pellet in any one column is bonded. It is obvious that a weakness of this design lies in the fact that an entire column of active material can slough out once the process starts at the bottom.

The "ironclad" plate consists essentially of a series of core rods attached to top and bottom frames and surrounded by perforated tubes, the annular space being filled by active material. This construction is well designed as it gives maximum surface per unit of weight and good retention of active material.

The modified grid has been designed for maximum efficiency. Heavy through members run diagonally toward the lug and are crossed by similar through members, producing a series of blocks bounded on all sides by these members. Individual blocks are completed by the introduction of staggered light members. A heavy, rugged frame completes the design. Maximum conductivity is assured and softening of the material in any block affects that block only.

ALLOYS AND CASTINGS

The alloys used for casting grids and small parts have a decided bearing on battery performance. An alloy of lead and antimony with very small amounts of metallic impurities is very generally used. The antimony content varies between approximately 2 per cent and 13 per cent, the latter being the eutectic. Considerable work has been done on alloys in which the antimony has been replaced by other metals such as calcium but none of them have been found commercially practical to date.

Molds for casting the lead-antimony alloy and casting techniques have kept pace. The type of steel or cast iron used in making molds is important as is the temperature at which the mold is operated. Improper pot or mold temperatures often result in poor castings even with the best alloys. Shrinkage cracks, poor inter-crystalline structure and dross inclusions must be avoided.

BATTERY OXIDES

The oxides from which plates are made have been improved markedly. Higher capacity, longer life and better cold weather performance are among the principal results. For example, the introduction of small amounts of certain types of organic material into negative plate oxides has tremendously increased battery performance at low temperatures. Microscopic studies of particle sizes and shapes have been responsible for improvements in oxides for positive plates in which maximum porosity consistent with long life is desired.

Several processes for making battery oxides are used. These include reverberatory furnaces, pot calcining, cupelling, the Barton process in which the oxide is produced by passing air over hot lead, etc. The oxides produced have definite characteristics depending on the manufacturing method. Careful studies of these properties as established by tests for particle size, apparent density, acid absorption and adaptability to specific processing methods are necessary. For example, particle size and shape have a very definite bearing on capacity and life. Fine and coarse particles separated from the same sample of oxide will be found to differ in both chemical and physical properties.

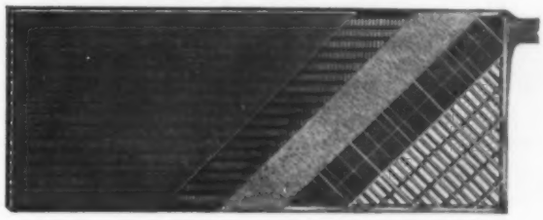


Figure 1 — An example of triple insulation in a storage battery.

SEPARATION

The mechanical insulation of plates of opposite polarity has an important bearing on performance and life. Originally separators used for this purpose were made of wood, cedar or fir for the most part. Two new materials have been introduced in recent years, rubber and glass, each of which has improved battery performance. Rubber has been used in two ways — as separators, when they replace wood, and in perforated or slotted sheets next to positive plates as retainers of active material. Glass mats serve in the latter capacity only. Excellent results are obtained with triple insulation. Glass mats are placed on both sides of each positive plate and are held in place by a pair of slotted, folded rubber retainers. Wood or rubber separators are then inserted between the retainers and the negative plates.

RUBBER AND SYNTHETICS

War-time restrictions have brought about several changes in battery construction, especially where rubber is involved. For example, extensive research has been necessary to produce satisfactory rubber jars from synthetic rubber due to modifications necessary in processing because of the critical nature of certain properties of the various usable synthetics. Some plastics, such as polystyrene and vinylite, have proven satisfactory for certain uses in batteries, such as retainers, moss shields, etc. Many plastics which are used extensively elsewhere have proven unsatisfactory due to inability to withstand the combination of

Figure 2 — View showing an excellent method for handling batteries off and on trucks.

sulphuric acid and strongly oxidizing conditions prevalent in storage batteries.

DEVELOPMENT AND RESEARCH

Any changes which may be proposed, either in the battery or external to it, must be carefully checked before being adopted. Many tests are involved, some of short duration and others requiring a period of several years in some cases. Capacity tests are run at high and low temperatures and life characteristics are checked by manual or automatic cycling. Accelerated tests are set up to determine the rates of grid corrosion and separator wear. Tests which duplicate, as nearly as possible, the use for which the battery is designed are run to determine the probably eventual cause of failure so that future development may be directed along proper lines.

It should be pointed out that all improvements made in batteries are inter-dependent. For example, if positive plate capacity is improved by the introduction of a new oxide, the negative plates must be improved correspondingly otherwise we no longer have the balance between groups essential to satisfactory performance. Similarly, when grid design is improved, thereby lengthening the potential service life, separation must be improved to match. Obviously each change made started a chain of investigations of other changes so that the storage batteries of today have become a dependable source of power surprisingly free from trouble.

ACCESSORIES

Problems external to the battery itself have also been given considerable study. One example concerns the rubber-covered cable used to connect the battery to the external circuit. Originally the wire was tinned and in the course of time corrosion took place, swelling the wire and causing failure of the insulation. The tinning of the wire was discontinued, a new protective coating of a special alloy, lead plus small amounts of tin and antimony, being substituted. In addition a tougher rubber covering was developed. Finally, after lugs as needed were soldered on, they were coined under pressure, thus insuring an acid-tight seal to the rubber covering. Recently a new method for applying lugs has been brought out which involves the use of a pressure high enough to compress the wire strands into a solid mass inside the lug. This method appears to have considerable merit.

CHARGING EQUIPMENT

The manufacturers of charging equipment have given much thought to our mutual problems and have designed equipment which is dependable and efficient. This means simplification of the problem of proper maintenance.

Figure 3 — Example of a well laid-out battery charging room.

Although there is no better method of charge regulation than manual control when properly handled, automatic charge regulation of motive power batteries has been developed to a point such that, when properly adjusted, it equals that obtained with the best manual control.

In the past, the name modified constant potential was applied to that method of automatic charge control in which there was one fixed resistance in series with the battery being charged from a fixed bus voltage. In the American Standard Definitions of Electrical Terms as published by the American Institute of Electrical Engineers appears the following:

"Modified constant-voltage charge — A modified constant-voltage charge of a storage battery is a charge in which the voltage of the charging circuit is held substantially constant, but a fixed resistance is inserted in the battery circuit, producing a rising voltage

characteristic at the battery terminals as the charge progresses."

In view of this we no longer refer to modified constant potential charge but use the new term modified constant-voltage charge.

MAINTENANCE

Too much emphasis cannot be given to the importance of maintenance. Good maintenance practices such as may be found in many of your plants very definitely pay dividends in added battery service life. Service men are available to check maintenance set-ups and to assist in the education of new men hired to replace those taken into the armed services or lost for other reasons.

The most important factors in good maintenance practice are proper charging, correct flushing, and cleanliness. No general procedure can be laid down as the requirements for each installation will differ to some extent and since charging affects flushing and hence cleanliness each set-up presents its own problems.

CHARGING

Years ago the modified constant-voltage method of charge regulation was used. It employed a fixed resistance in series with the battery being charged from a fixed bus voltage. A value of 2.63 volts per cell bus voltage was recognized as standard. In the course of time efforts were made to improve charge regulation by increasing the bus voltage. This resulted in a slight reduction in the actual size of charging equipment required. After approximately five years experience it was found that the high bus voltages used for modified constant-voltage charging did not accomplish all of the desired results and recently the industry recognized that 2.63 volts per cell bus voltage was the most desirable to use and that is the standard recommendation now as made by the Industrial Truck Statistical Association.

There are certain installations which require a complete recharge in 8 hours where the batteries work in relatively hot atmosphere and battery temperature is invariably between 95 and 110 F. Temperatures in this bracket have a tendency to cause the end of charge rate to the battery to be above normal and if sufficient resistance is introduced in the circuit to result in the published finishing rate or slightly lower at the end of charge, it sometimes will limit the start rate. The result is that the charge requires somewhat more than 8 hours. Where this is objectionable, the two rate method of charge control can be applied.

The advantages of two rate charge control are that both the start rate and end of charge may be adjusted independently, whereas with the modified constant-voltage method of charge control, an adjustment of the resistance in series with the battery will cause a change to both start rate and end of charge rate. When two rate charge control is initially chosen, the generator voltage selected should be no lower than 2.70 volts per cell and no more than 2.75 volts per cell.

FLUSHING AND CLEANLINESS

For safe and satisfactory performance, batteries should be kept clean. The amount of cleaning required will depend on the conditions under which they operate and on the surroundings. Avoidance of overflushing will help naturally. Batteries may be cleaned by air, water, or by wiping with rags. Should there appear to be much acid present, it may be neutralized with common washing or baking soda. Do not allow the soda to get into the cells.

The electrolyte level should not be allowed to fall below the tops of the separators and when adding water, it should not be allowed to rise above a point slightly below the bottom of the vent well. If the level falls to a point below the tops of the plates, that portion of the plates which is exposed becomes inactive, putting an extra strain on the balance. On the other hand, the addition of too much water when flushing will cause the cells to overflow when gassing with loss of acid, excessive corrosion, etc.

Should any question arise as to whether the local water is satisfactory for use in batteries, distilled water should be used until the local water has been checked by analysis. Impurities in the electrolyte in minute quantities may seriously affect battery performance. Similarly if any foreign matter, metallic or otherwise, should get into a cell, it should be promptly removed if solid, and the cell dumped and refilled with fresh acid of the same specific gravity. If contamination is suspected, it may be well to have the acid which is removed from the cell checked.

SUMMARY

The motive power battery of today is the result of a study of maintenance problems and of developments in general. A few examples of the improvements effected will emphasize what has been done.

In the past, battery life has often been controlled by grid failure due to corrosion. The new grid designs which have been described, have minimized the possibility of such failure due to their ruggedness and great mechanical strength.

Internal shorts due to the accumulation of sediment or separator failure are practically non-existent as a result of improved retention and insulation due to triple separation.

Capacity has been increased so that it is rarely necessary to boost a battery during a shift. Batteries can be supplied with up to 10 per cent more capacity in a given space.

Steel trays are a factor in longer life and easier maintenance. A battery made up of elements in rubber jars assembled in steel trays will stand considerable abuse.

In general it may be said that the present day battery, which has been carefully engineered for steel mill and equivalent industrial services, can be depended on to handle the heaviest industrial truck and locomotive operations with a minimum of maintenance just as does any other piece of reliable electrical equipment.

MAINTENANCE OF STEEL PLANT

Instruments and Controls

by W. J. McGregor

▲ AS the art of steelmaking has progressed, the need has arisen for closer control of the various processes involved, and as competition has become more keen, closer control of costs through metering of utilities and fuels has become a necessity. Systems of process and combustion control and utility measurement are used in all divisions of the steel plant from the by-product coke department to the various finishing mills turning out the final completed product.

As control systems have become more complex and metering systems larger, the problem of maintenance has demanded more attention. Instead of instrument maintenance being handled as a side issue by a group primarily interested in some other phase of the plant, the need arose for a separate organization to be set up to handle instruments and controls alone.

The organization taking care of instrument and control maintenance should be entirely separate from any operating division of the plant. The logical department for this organization to be associated with is either the maintenance, fuel or steam department. This type of departmental tie-in will tend to give the organization an impartial approach to the problem of taking care of the equipment in the various operating departments.

The supervision of the maintenance of instruments and controls should be in the hands of a thoroughly trained technician who is not only capable of supervising the maintenance of the equipment but who is also qualified to recommend the proper equipment to use in new installations and to supervise its installation so that future maintenance will be kept to a minimum.

The repair crew should be composed of men with sufficient technical training to appreciate and solve the problems which they encounter in the course of carrying on their duties. They should be trained in instrument and control work so that they have the skill necessary to do a first class maintenance job. The natural tendency is for men to specialize in the repair of some particular type of control or instrument, and it is a good tendency, for then there is someone available who knows each piece of equipment thoroughly. However, care must be taken to see that all men attain a certain degree of skill in working on all equipment. The repair crew must be versatile if maintenance work is to proceed without delay under all reasonable circumstances.

The duties of this maintenance group should include specifying the instrument and control equipment to be used in new installations. This is important as it gives them an opportunity to follow some systematic plan in standardizing in the particular type of instruments for certain types of duty. They are also able to choose equipment which will fit in with their maintenance schedule. As a rule instrument maintenance departments are not overmanned, particularly at the present time. If an instrument or control which is too delicate or otherwise unsuited for the job is specified by some well-meaning but inexperienced individual, then the plant as a whole suffers, as the time necessary for the maintenance of that equipment will have to be taken from the equipment in other parts of the plant.

Installation of instruments and controls should also come under the direction of the maintenance shop, as no one knows better the problems of maintenance that can be introduced by poor installation than the man who has the task of keeping the equipment operating properly. A few of the important points from the maintenance man's viewpoint are:

1. Impulse lines to controls and instruments should be installed so that they will collect a minimum of dirt from the boiler, pipe line or wherever they are connected, and provision should be made for the easy removal of the dirt that does accumulate.
2. Thermocouple and other temperature measuring devices should be properly protected from mechanical injury so that their replacement will be kept to a minimum.
3. Provision should be made for properly cleaning the operating medium for controls. Filters should be provided for compressed air, water or oil to prevent foreign matter being carried into the pilot valves and cylinders.
4. Cabinets should be provided where needed to protect instruments and controls from dirt, which is a major difficulty around steel plants.
5. Meters and impulse lines, where filled with water, must be protected from freezing. Often the location of the orifice or other primary device is dictated by existing plant conditions, since many of our meters and controls are built into and around existing equipment. Conditions such as this often make it necessary that the meters and impulse lines be located outdoors, in which case protection against freezing can be given by installation of steam tracer lines or

electric heating cable. Care must be taken to avoid overheating or uneven heating, as inaccurate meter readings will be the result.

6. In installing instruments and controls, care should be taken to follow the recommendations of the manufacturer of the equipment. This should be checked by the maintenance force, as much future trouble will be avoided if this is done, because the maker's suggestions are based on wide experience.

Once the control or measurement equipment is installed, the problem is maintenance, and the more systematic the setup, the better the job will be done.

1. Necessary spares should be stocked so that replacements can be made promptly when needed.
2. A schedule for general overhauling of the equipment at regular intervals should be set up and carefully followed. By properly following this procedure, the majority of the breakdowns and consequent rush repair jobs can be avoided.
3. Also schedule minor maintenance jobs such as blowing out impulse lines, cleaning temperature elements and pyrometers, and replacing thermocouples so that operation of equipment can be kept at a high level of efficiency.
4. A complete record of each installation should be kept and carefully filed and indexed. This record should carry the complete history of the piece of equipment, including data on the primary element and the instrument itself, date of installation, major repairs made and parts replaced. In this manner the characteristics of each instrument will become known. This record is a great aid in scheduling overhauling of the instruments and controls, and in addition is valuable as a reference when similar equipment must be purchased for new installations.
5. Inspection of all instruments and controls should be made daily by the maintenance men. If daily inspections are not practical then they should be made as often as possible. This inspection is intended to be only an external inspection. On a meter, the inspection would cover the clearness and apparent accuracy of the chart record, the accuracy of the integrator action and a check for leakage from the meter lines or body. In checking a control the most important consideration is whether the equipment is doing the job which it is set up to do. Unless some record of past performance is available, an intelligent decision is difficult to make. For that reason all control systems of importance should include an instrument to make a chart record of the flow, temperature, pressure or whatever is being controlled.

Changing of charts on instruments can be under the jurisdiction of the instrument repair division or it can be handled by the operating personnel. It has been our experience that the charts are in better condition and that there is less wear and tear on the instruments when chart changing is taken care of by someone who is doing that work on a full time basis. In addition, the inventory of new charts is concentrated in one location and consequently can be considerably smaller. Used charts can also be filed in a central place where they are available for future reference.

Now that a general outline of the organization and procedure for handling instrument and control maintenance has been set up, let us look at some of the problems which arise.

Going back to the schedule for general overhauling of instruments and controls, our experience has been that six month intervals are on the average about the proper timing. Of course there are meters on lines carrying dirty material which require much more frequent cleaning, sometimes as often as once monthly. Even in these cases proper installation will go far towards eliminating the trouble. Proper sized settling chambers will keep the meter clean, but the orifice taps and meter lines must still be cleaned out by flushing. In some cases the primary elements must be cleaned. We have two meters on river water lines, in which pitot tubes are inserted as the primary element. This was necessary since the lines could not be shut down to allow the insertion of flanges and an orifice. These primary elements must be cleaned weekly as a regular schedule, and when the water is especially dirty, as in flood time, daily cleaning must be resorted to.

Another trouble we have experienced is a build-up in the orifice taps and reservoirs on steam meters. This deposit has been analyzed as iron oxide. One of the meter companies is of the opinion that use of stainless steel nipples at the orifice will eliminate the trouble. So far we have not had the opportunity to try this remedy.

A current problem being considered is corrosion of orifices in compressed air lines. Recently we had occasion to change an orifice which had been in an air line for almost five years. The orifice was made of stainless steel. When removed it was almost entirely eaten away. It is planned to inspect the new orifice, made of monel metal, periodically, to check its condition.

In older mills, problems are occasionally inherited from the past. Sometime ago, trouble was being experienced with a water meter, the orifice for which was installed in the water line between a pump taking water from the river and a barometric condenser. It was difficult and sometimes impossible to keep mercury in the meter body. Considerable time was spent investigating the trouble but eventually it was found that it was due to the orifice being close enough to the entrance to the condenser that one of the meter impulse lines was under a vacuum part of the time. When the orifice was moved to a lower elevation the trouble was eliminated. Due to the fact that there were no records on meter performance, it will never be known just when the trouble developed.

Occasionally trouble is experienced with new metering equipment. It must be said however that these have always been comparatively minor items. The manufacturers give the ultimate in instrument accuracy but when it comes to some simple piece of hardware little attention seems to be paid to quality. If all the flimsy door catches and skimpy electric plugs could be replaced by good substantial products, many of the maintenance man's troubles would be over.

On the whole, instrument and control maintenance in the steel plant is no different than in any other plant. I believe that the chief differences are the great variety of metering and control problems, the bad conditions of dust and grease, and conditions of extreme heat in some cases and exposure to the weather in others.

SOME PROBLEMS OF

Electrical Maintenance

by H. L. Coe

▲ ELECTRICAL applications in the steel industry have grown from the small beginning made in 1892 when a few early type motors were applied to mill auxiliaries (notably cranes), through 1905 when the first main roll drives were motorized, and up to the present time in which we see electricity and electrical equipment functioning in every phase of the industry. In the newer mills the only source of power is electrical power derived from motors ranging from the smallest size imaginable to giants of 7000 to 10,000 hp the largest in the world. This great growth has brought with it, in increasing importance, the problem of scientific electrical maintenance. Many of the problems of electrical maintenance are common to all classes of maintenance. The one problem under which all others fall is the problem of cost reduction.

There was a time when maintenance was considered by many to be a necessary evil. However, a large part of the blame for this attitude could be thrown into the laps of maintenance men themselves because of the fact that they, in many cases, failed to present an organized program of real maintenance, but rather allowed our organizations to grow up to be an organization of fixers and repairmen.

It is in no small measure due to the work of the Association of Iron and Steel Engineers that this attitude toward maintenance is disappearing. In its place is a growing appreciation among operators and management of the problems of maintenance — and among maintenance men of the effects of the overall cost of maintenance upon final product cost.

The cost of maintenance is just as real a cost as is the cost of any raw material entering into the iron and steel process. Because of the highly competitive position in which the iron and steel industry finds itself today, the difference between high maintenance costs and low maintenance costs may well mean the difference between our company's making a profit on production or taking a loss.

I believe that the first problem of maintenance in general is one of reducing costs of maintenance. How are we going to do this? First, we must pay more attention to well thought-out programs of preventive maintenance. Preventive maintenance applied to electrical equipment particularly implies that, through records of service and failures, we will be able to anticipate the safe operating periods of equipment such as motors, generators, roller bearings, and many types of control equipment, then definitely schedule the removal of this equipment from service for cleaning, drying out, varnishing, or whatever procedure is necessary to restore the equipment to as near perfect condition as possible.

In many papers presented before this Association in the past few years, various plans of preventive and planned maintenance have been discussed. There is little that I can add in the way of new thought on this general subject. I know it is generally recognized in principle as being the cheapest kind of maintenance in the long run. It will remain for each plant or operating unit to set up its own program to suit its own particular set of conditions.

We all realize, of course, that under the record-breaking operating conditions we have today we may not be able to go as far as we would like in carrying out a comprehensive scientific plan of preventive maintenance. However, much good can be done in most plants if a system of records is properly maintained and followed through.

In addition to the usual card record of motors and generators on which service data are recorded, we find it helpful to keep a record of periodic megger readings on larger equipment. It has not been found economical to try to keep megger records of all electrical equipment, but to limit these records to equipment which is of vital importance to operations and to motors and generators of 300 hp and larger. It is particularly desirable to pay close attention to this record on such items as primary generating equipment, vital pump motors, blast furnace skip hoist motors and control and the like. These readings may be taken at different intervals on different equipment depending upon its importance. Usually once each month on primary generating equipment and once in 3 months to 6 months on other equipment is sufficient. Regularity is most important in plotting and interpreting trends in megger readings.

The second important element in cost reduction at any time (and very important now) is the training of competent personnel. The manpower situation is becoming increasingly difficult and that is all the more reason to keep the personnel we have as effective as possible through a comprehensive training program.

Electricity as a science is perhaps more technical than most other sciences. Proper and effective maintenance

of electrical equipment probably requires more technical background on the part of the workmen themselves than the proper maintenance of most other types of equipment. It requires that a man have a good knowledge of mechanics as well as a knowledge of electrical theory and its practical application. I believe the time has passed when we can develop men competent to deal effectively with modern equipment without giving them competent instruction. To meet this problem we are holding classes of instruction for all classes of electrical men. The foremen are usually the instructors because we feel that there is less likelihood of conflict of opinion between individuals if the foremen take time out and instruct their own men.

These classes usually take the form of round table discussion about some particular type of equipment. The equipment is brought into the classroom and discussed as a unit, then taken apart and the theory and function of each part discussed, along with proper methods to be used in its maintenance. We acquaint the men with the parts which may be likely to fail in service and what to do to correct difficulties that are thus foreseen. We find that the men are much more interested in this type of instruction than they are in classes run purely on a theoretical basis.

We have been fortunate in having a number of our men enrolled in courses given locally in connection with the government training and upgrading programs. Some of our foremen have acted as instructors in these programs with considerable benefit to themselves as well as our men. I feel that the training aspect cannot be too strongly stressed as a means of obtaining better maintenance at lower costs.

The third important thing, which in my opinion will enable us to further reduce maintenance costs, is standardization. There has been a considerable amount of standardization accomplished in electrical equipment. The standardization of mill motors as to ratings and size, the standardization of contactors and control, the standardization of mill crane specifications and many other accomplishments have been of great value. There is room for more.

Two of the things which give maintenance men a great amount of grief today are lubrication and carbon brushes. As you all know the confusion which exists today in regard to these two important items is serious. The application of lubricants is still a matter of trial and error both on the part of lubricant experts and manufacturers, and on the part of maintenance men. There are differences of opinion as to what characteristics a lubricant must have for a particular job. Proper lubrication of a piece of equipment usually is the result of many trials, many observations, much expense and often much abuse of equipment until finally the correct lubricant is found.

The SAE specifications on lubricants is inadequate to determine the overall performance of any oil or grease. It seems to many of us that some set of standards are badly needed which will give us a measure of the various elements to be considered in a lubricant, such as:

A. Film strength at various temperatures.
B. Viscosity, not at 100 C and 210 C but at—20 C, 0 C, 30 C, 70 C and 100 C.
C. Resistance to oxidation, sludging and acidity.
D. Resistance to water emulsification.

To assure proper maintenance and prevent sparking, it is necessary to undercut the mica below the surface of the faster-wearing copper commutator bars on a direct-current motor. This tool undercuts the mica to 1/16 in. below the commutator surface.

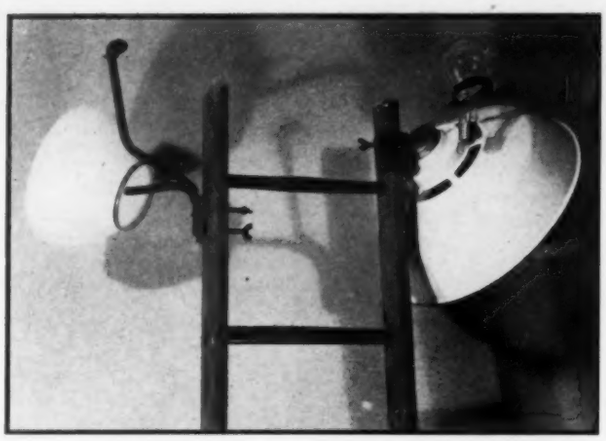
I know that much progress has been made in lubricants in recent years, but the knowledge of this progress is not correlated or tabulated for general use.

It would seem that a great service could be rendered to the steel industry if lubrication engineers could get together, decide which factors should be measured, set up standards for their measurement, and gain the cooperation of the lubricant manufacturers in standardizing their products. If this were done, it is possible that a few types of fluid lubricants and a few types of greases would be sufficient to meet most requirements instead of dozens as we have now. One salesman told me the other day that he had 155 different grades of oils and greases to sell.

Carbon brushes are even worse. In the past 17 years of experience I have come to the conclusion that we know very little about commutation yet. We probably know more than we did 20 years ago; the brush manufacturers have spent money on development and time in application work, but the application of carbon brushes is still about 75 per cent guess work. Much money is spent every year by the iron and steel industry in trial and error testing.

The answer to this problem is not apparent. The state of the art or science may not be ripe for investigation at this time. However, I believe the time will come when something can be done and there is certainly no better place in which to stimulate thinking on the subject than among the members of the Association of Iron and Steel Engineers.

The fourth problem which I should like to discuss has to do with maintenance materials and methods. The war has taxed our ingenuity in many ways to use less critical material. The government regulations prohibit use of materials which had grown to be standard in our plant, and force use of less substantial construc-



Close-up showing rubber-covered brackets mounted on ladder facilitating the handling of the various parts in maintenance of illumination installations.

tion methods and materials which in the end will raise maintenance costs.

We used to think we had to have a high tin babbit for motor and generator bearings. Mechanical maintenance couldn't use less than 80-90 per cent tin in roll neck bearings. They found that lead base babbits ranging 3-10 per cent tin was in some cases even better than the tin base babbits. We have been using with great success a lead bronze, equivalent approximately to SAE 64, containing about 80 per cent copper, 9 per cent tin and 11 per cent lead in older type mill motor bearings with grease and oil lubrication instead of high tin content babbit as formerly. Bronze bushings were designed to shrink fit into the babbit shell and then brazed around one end to prevent the bronze from turning in the shell. These bearings are lasting on reversing, plugging, heavy duty service four to ten times as long as the babbit bearings lasted. We are one of the plants which still operate large numbers of older types of motors on table drives, cranes, etc. We have no more trouble with them than we have with more recent motors. The bronze bearings cut bearing maintenance costs on these motors to about 20 per cent of the cost with babbit bearings.

The use of low tin content solder was thought to be impossible, at least in armature winding. However, we have had good results with a war alloy of 20 per cent tin, 2 per cent silver, about ½ per cent bismuth and ½ per cent antimony, and 77 per cent lead. This solder satisfies our maintenance men as well as 50 per cent tin, 50 per cent lead solder, and in addition has a higher melting point which is advantageous, especially on bands.

We are now winding all mill motors and many others with class BBB insulation which is largely mica and fiber glass. This has a somewhat higher first cost but has paid big dividends in maintenance costs on motors. This, together with the use of synthetic type varnish and infra-red heat in baking, have all combined to give us an average time in service for d-c armatures over 150 per cent longer than was the case before adapting these measures.

The use of one type of baking varnish, and dipping armatures all the way over the commutator and front V-ring, has in general cut down on many types of armature failures formerly encountered. The dipping is done before turning and undercutting, which is the last operation, so the varnish which gets on the commutator does not hurt anything.

Infra-red baking and drying out of electrical equipment has proved a big money and time saver. We have portable racks built up which can be taken to the job instead of taking the job to the oven, as before. This saves a lot of work in field jobs. The time to heat a 50 hp armature before dipping used to be 4-6 hours in the old convection oven. We do it now in about 1½ hours with infra-red. The time to bake one coat of varnish used to be 18-24 hours; we do it now in 8-10 hours with infra-red. Another advantage is that we do not get pockets of uncured varnish left in some parts of the armature to throw out after the motor goes into service as we used to get with convection baking. The total power input to the infra-red lamps is about the same as we formerly had in the oven and, since the time is less than half, the power consumption is less than half that required by the old method.

The application of suitable steel cable lubricant which will not come off and which will stick to cables on outside cranes in all weather has resulted in considerable savings in cable usage.

These things and many other similar improvements in equipment, materials and methods have proved to us that we are never too old to learn new tricks. The war and its emergencies have served the purpose of teaching us a lot of new tricks and will, no doubt, teach us more as time goes on.

To summarize the foregoing, the most important problem of electrical maintenance is cost reduction. In order to accomplish this end we must consider:

1. More emphasis on planned preventive maintenance programs.
2. Better and more rapid training of maintenance personnel.
3. Greater degree of standardization of equipment and materials of maintenance.
4. Considerable attention to new and improved maintenance methods and materials.

DISCUSSION

PRESENTED BY

CHAS. L. McGRANAHAN, Assistant General Superintendent, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania

L. R. MILBURN, Electrical Engineer, Great Lakes Steel Corporation, Ecorse, Detroit, Michigan

E. G. GERBER, Diamond Carbon Company, Pittsburgh, Pennsylvania

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R. A. LAMBERT, Combustion Engineer, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania

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ERNEST REHNBERG, Special Lubricating Engineer, Keystone Lubricating Company, Pittsburgh, Pennsylvania

H. L. COE, Assistant Superintendent Maintenance, Carnegie-Illinois Steel Corporation, Clairton, Pennsylvania

J. S. MURRAY, Chief Electrical Engineer, Follansbee Steel Corporation, Follansbee, West Virginia

OTTO J. LEONE, Bristol Company, Pittsburgh, Pennsylvania

W. C. HOGG, Division Superintendent, Steel Works, Carnegie-Illinois Steel Corporation, Clairton, Pennsylvania

Chas. L. McGranahan: As an operator I am in accord with everything Mr. McGregor said in his paper with respect to maintenance. I have not bought any instruments for several years, but it would be a great deal of help if the manufacturers would have more standardization with regard to size. It seems an imposition to have to buy a spare for each instrument. It is not always convenient to take an instrument out of service long enough to do an A-1 job. I agree with Mr. Coe that the standardization of brushes has not reached the stature either of an art or a science. This opinion has been formed by the number of requisitions I have to sign for brushes and brush holders.

L. R. Milburn: In regard to Mr. McGregor's paper on steel plant instruments and controls, I sometimes wonder if we don't go too far in regard to metering. However, I will say that it gives us a better distribution of cost on the essential items such as steam, power, acid and possibly water, where water is a major cost of operating a plant. I think we should measure our liquid and gaseous fuels.

We realize that it is hard to standardize on meter types as the art is continually changing; however, we, as engineers, could possibly use less of a variety. We could also bring pressure to bear on the instrument manufacturers to make various meters interchangeable within the near future.

Mr. Robinson's paper on pipe cleaning clearly shows the possibility of future savings through less maintenance shutdowns and delays by the utilization of this method of pipe cleaning. In other words, this is preventive.

The solution to all electrical and mechanical maintenance problems is preventive or planned maintenance. The person best suited to do this is your chief engineer. He is the one who plans and installs your mill equipment. He consults with the operating departments as to what, how and when they want to produce saleable material. He should know best what a piece of equipment can withstand in the way of usage and abuse. The chief engineer is the one who can best plan for maintenance of this equipment. He is in a better position to plan the need and time of preventive maintenance. With this type of maintenance your mill delays will be less expensive, and your production will be more continuous. Costly breakdowns of vital equipment could thus be prevented.

With regard to battery maintenance, I am in no position to comment as we have only two small battery-operated units in our plant. Each of these has only one battery, and there is a charging station available for each of them, so located that they can take on a charge during their waiting time. These two units do not operate to excess and, therefore, we have had no maintenance problems with the batteries. Practically all our industrial haulage is done by gas-electric power.

I firmly believe that more thought should be given to planned or preventive maintenance in our steel mills. When planning equipment or installations we, as engineers and operators, try to anticipate reasonable future conditions and we should at the same time plan our preventive maintenance for this equipment.

E. G. Gerber: My experience in electrical maintenance work goes back to the time when we boiled carbon brushes in oil or paraffine, dried them out and thought we did all right.

With undercutting, shunting and grade improvements that have followed, progress was rapid because there was so much more knowledge of what was needed. Now we know that the life of commutators is considerably improved and the performance of brushes is always improving.

One of the things which perhaps leads us to think that the carbon brush is not improving is the over-optimism of a salesman or engineer, who in his desire to help, believes he can accomplish results with a brush, which are beyond his ability.

One of the things which might help in maintenance work is the fitting of brushes to commutators on series type motors for cranes and tables. I know from experience that it is very difficult to sand a brush on these motors, and if a square end brush is applied, the result is a line contact of high current density and commutator damage is done before the brush is properly seated.

To correct this condition, the suggestion is made that all mill type motor brushes with square end be concaved to fit a new commutator. The difference between the fit on a worn commutator and new commutator is very slight and will help operating conditions.

One more suggestion would be the periodic check up of wear in the brush holder, particularly in the thickness dimension. Brushes are made to very close limits, such as .002 in. oversize, while brush holders are generally made .005 in. oversize, so when a brush holder is worn .010 in. oversize, there is considerable free play which on a reversing motor is generally indicated by a very prominent mark parallel to the commutator bars on the brush face. Good maintenance would indicate that these holders should be repaired or replaced.

L. F. Coffin: I might add a little to the discussion on pipe cleaning. At Sparrows Point we use salt water and it may be interesting to know that salt water lines deposit considerable hard material due to a micro-organism which lives in the water, eats iron out of the water and deposits on the pipe. We have very successfully cleaned some salt water pipes. One was 14 in. in diameter, probably one-half mile long, and it took three runnings of the hydraulic system to do the job. In

order to prevent formation of deposit in salt water lines, we are now using chlorine gas, one part per million, during the spring, summer and fall months. Inasmuch as we are dealing with a living organism, chlorine kills the living microbe and prevents the deposit.

With reference to Mr. Coe's comments, there appears to be some room for a difference of opinion on the subject of bronze bearings as against babbitt. We feel the tendency should be away from bronze and towards babbitt, even with the loss of availability of tin babbitt. In one plant the consumption of tin base babbitt has been reduced from 95,000 lb per year to 1500 lb. Where you use an arsenical lead base babbitt, you are using a babbitt which has practically the same strength under elevated temperature conditions as tin base babbitt, and if you can properly bond that babbitt to the shell, you then have a bearing that will assure giving strength to the babbitt. Arsenical lead babbitt has slightly less ductility but in all other respects is equal to tin base babbitt. There are two effective methods of bonding this babbitt to steel shells and one effective method of bonding to cast iron shells, either new or old. We have a blast furnace gas electric engine, 3500 kw, operating for over a year, having a 22 in. diameter crank pin with arsenical lead babbitt in the crank pin box. We have had very little difficulty with it and very little keying up. The tendency ought to be toward babbitt because it is a better wearing material and produces less wear on the journal.

R. A. Lambert: There is one thing I might add to what Mr. McGregor has said. It seems to me that the operating people do not take the interest in recording charts that they should. I think many times when we have a record, if it were scrutinized more carefully, it would clarify operating difficulties a great deal and result in economies.

R. A. Weikel: Mr. McGregor's paper was of particular interest to me and I am fully in accord with what he has said. I like to compare instruments with automobiles. Most of us service our automobiles with great regularity, having the oil changed and the car lubricated at fixed periods. However, the users of instruments have not accepted the service requirements on instruments with the same degree. Many users expect instruments to function perfectly for an indefinite period without service or with a mediocre type of service, which again we would not accept on our automobiles.

A remark was made about having instruments alike or interchangeable. You have used a lot of different models in your mills, perhaps some made by the same manufacturer. Comparing this thought with automobiles, most of us do not expect too much in the way of spare parts from an automobile manufacturer if an automobile is several years old, and yet the writer's company was criticized recently for being unable to supply replacement parts for an instrument that had given good service for twenty years. Before the war automobile models changed yearly, and we accepted the new models as they came on the market and were not too much concerned with obsolescence. New improvements to give better performance means a continual change of any manufactured article. These improvements are demanded by the operators. It would simplify our business to a great extent if we could adopt standards. Round charts and strip charts — long a controversial subject — are a good example of this. Instrument manufacturers have adopted both because operators want both.

R. H. Ellis: The use of instruments for electrical maintenance in the steel mill is a subject in which the writer always has been very interested. In the past, when control boards have been ordered, a meter and shunt have been applied to the line circuit of the panel. In the future, especially where armature shunt slowdown is utilized, a recommendation will be made for the use of two shunts, one in the line and one in the armature circuit, and when the war situation is over, the panels should be supplied with two meters.

It is imperative, if the panel meters are not mounted on the panels, that the electric maintenance personnel be provided with graphic meters which are available for quick service. If the meter is not handy, primitive methods of checking are used and usually the motor and control are put back into service without the true cause of the trouble being ascertained.

When new installations are made it seems to be standard practice for the panel to be wired to the motor and put into service with resistor values and acceleration times as shipped from the factory. Each mill type application is a separate study and no mechanical equipment should be operated without a graphic record of the functioning of the motor and control. On usual mill machinery this requires a zero center meter and the record should be made of the armature circuit.

The discussions on carbon brush troubles have been very interesting but I have run into troubles lately which have been simply neglect. The most recent case was on a large machine where the brushes had never been sanded to fit the machine. Certainly this should not happen but it is up to the men in charge of installation to see that little details are not the cause of possible serious failure of a machine.

Ernest Rehnberg: Mr. Coe stated that he occasionally had trouble with ring oil bearings, particularly in motors and motor generator sets, due to oil creepage. This oil, he said, crept into and contaminated the armature and field windings, as well as fouling the commutators.

The writer's company licked this problem 40 years ago with a liquid grease. This grease flows like oil, looks like oil but is every bit as much a grease as is our cup grease, except it is made in fluid form. This liquid grease has greater resistance to capillary attraction than ordinary oils and stays put in the bearings. Because it establishes a grease film instead of an oil film, and because it does not thin out under heat, it has proven a welcome cure for hot ring oil bearings in many different types of industry. As a matter of fact, this very statement is published in our application guide.

We began working on this 40 year old cure back in 1902 or 1903. Our first contact with ring oil bearings occurred in Providence, Rhode Island in the city electric light plant. There were several generators in this plant which were equipped with ring oil bearings which, lubricated with oil, were giving very unsatisfactory results. Subsequently, ring oil bearings appeared in the large plants in Providence and installations of ring oil bearings were made on shaft hangers. As a result of the evident need, a liquid grease was developed to meet the "evolution" in bearing design.

The first batch of liquid grease, to which we gave the designation of "No. 6 density", was manufactured in the forepart of 1904. Before samples were submitted for actual industrial service, they were first tested in the laboratory of the Wm. Cramp and Sons Ship and Engine Building Company in comparison with the then popular and generally known "engine and machine oil". The comparative results with the new grease and the oils indicated a lubricating value in the grease very much superior to that of the oils. We then felt justified in sending samples to Providence for a test in the generators of the electric plant.

The bearings on these generators had been running excessively hot, but shortly after the new grease had been introduced into the bearings this heat diminished, in one instance as much as 50 F.

Further extended tests were made beyond the scope of ring oiling bearing practice. The grease was used in small oil wells with which the machines were then equipped. This was long before the age of pressure fittings and many grease cups of the hand compression type were used. It became apparent very soon that the grease was a lubricant that stayed put in the bearings and was not so wastefully fluid as ordinary oils. True, it was a liquid, but a liquid with a body, a liquid that seemed self-contained and which, when in contact with a metal surface, would cling with a most unusual and extraordinary tenacity. It had a much greater surface tension, and was more capable of preventing metal-to-metal contacts under normal and abnormal loads.

H. L. Coe: Our practice is to treat it with the idea in mind that each strand has a bearing surface against each other strand. From our experience with cables, the type of lubricant which gives the best service has more of a rubber consistency, will retain its plasticity and lubricating properties in adverse temperature and weather conditions, particularly on outside cranes. We have had success with one in particular and some success with two or three other types of lubricants made. In general, they are real lubricants and give you the service which you need when lubricating for hard service.

J. S. Murray: I would like to ask what type of wire is used in thermocouples at temperatures of 2000-2200 F.

R. A. Lambert: For temperatures between 2000 and 2200 F we use platinum — platinum rhodium couples. However wherever we can economically we are converting to radiation pyrometry because we think them more easily serviced and cheaper in the long run.

Otto J. Leone: Several points have been mentioned on instruments, one pertaining to the number of instruments used, the other point concerning standardization.

With reference to the first point, there are yet many other functions which operators would like to measure, record and control if possible. For example, it would be desirable to record the percentage of CO and other gases leaving the blast furnace, or the ratio of $\frac{CO}{CO_2}$; to know how many grains of moisture in each cubic foot of air going to the furnace and to keep it constant. Many measurements now being made in the laboratory may some day be recorded automatically and continuously by instruments. As time goes on more and more instruments will be applied to furnaces.

The statement made that the instrument makers have lagged behind the steel industry in standardization may be true in some respects, but we have standardized as far as we can. For example, on pyrometers we have standardized in thermocouple materials and calibration curves; the same applies to flowmeter calibration.

The war, however, has made it difficult even for individual companies to maintain their own standards. For example, we used to furnish round and rectangular recorder cases of aluminum, brass or steel. Because of a War Production Board order governing the use of critical materials, we were no longer permitted to furnish aluminum cases, we then had to go to a war model rectangular steel case. In one type of recorder, although we had been using a standard motor, we were forced to use any one of three different makes of motors.

While we are on this subject of standardization, I could mention numerous instances where men in the steel mills have been guilty of violating standardization themselves. As one example, I mention the use of substitute charts on recorders. The trend of individual companies has been to reduce the types of charts and to standardize on universal charts, which can be used say on pressure, flow, level or thermometer gauges alike. Some mills, however, have been buying substitute charts which are not made from an original calibrated plate, but are less accurate facsimiles of the original. Often the chart paper is inferior and thinner, the chart glaze is poor, the paper is greatly affected by humidity because of poor hygroscopic properties, and the centers are often out of round.

Because the instrument companies sell not only to steel mills but to people who must have chart accuracy, such as gas companies, we must use only the best methods and materials in making our charts. The mills that buy substitute charts invite confusion in keeping chart records straight by having to use several chart numbers for a given recorder.

One other reason we find it difficult to standardize is because many instruments are custom jobs with specifications to suit particular applications and local conditions. The gas companies which we just mentioned, for example, may require a spring chart drive if the recorder is to be placed where no electricity is available; most steel companies, on the other hand, use electric chart drives; these may be 25 or 60 cycle depending on local conditions. Even within your own plants you will not standardize. The coke works may insist on spring wound chart drives, the open hearth department may prefer 60 cycle motor drives, whereas the blast furnace will want 25 cycles. In other words, we cannot standardize any more than you will let us, as we have to give you what you want.

W. C. Hogg: I have always been interested in control instrumentation and used to work directly with the instruments myself while in an operating position. However, I have found that the tendency of most operators — including myself — is to install an instrument and then to expect it to do the job by itself from then on. The narrower the control limits or the greater the accuracy of a meter, naturally the more delicate becomes the instrument and the greater the need for careful and constant maintenance.

Thus, in a plant using a great number of meters and controls, there is a definite need for a group qualified to service them separate from ordinary maintenance work. In such a group, however, there is a tendency to look at the instruments from a purely mechanical angle without due regard for the practical use which is its original and real purpose. For this reason, the personnel of the group, particularly the head man, must have imagination enough to combine maintenance with application and interpretation.

H. L. Coe: I would like to clarify my remarks in regard to bronze and babbitt. I did not mean to leave the impression that babbitt was out as a bearing metal. It always will have an important place in bearings. It is an important type of bearing. However, I did refer to the application of bronze in some older types of motor bearings in preference to babbitt, for reason of the fact that babbitt is hard to hold in steel shells or cast iron shells in thin layers, particularly in motors subject to reversing and subject to vibration. We have more success with bronze in that particular application. That is one of the applications for which bronze is suitable; there should be others. But do not take that to mean that babbitt is out or should not be considered as desirable as formerly.

The remark was made that certain oils will prevent oil throw in bearings. It is true that oils with adhesive properties will reduce oil throw; however, if bearings are not perfectly seated in the motor case, of if the fit of your bearing is not good some oil will find its way out. Oil and grease cannot overcome all of those things, and some oil will get into motors. We try to see that the fits are good and that the caps are tight, and maintained so by a paste we use between top and bottom half of bearings which prevents oil from leaking out, and by using oil seals.

The point I want to make is, that there seems to be a lot of room for standardization of lubricants. It may be that iron and steel men are to blame, due to the fact that each operator seems to think he wants his own particular grade, a different viscosity oil or different density grease. All of those things could be narrowed down if a comprehensive set of standards, standard tests, standards of performance, could once be established. I believe there was a time when many steel mill men did not want to adopt the standard motor, but a great deal of progress has been made which resulted in savings; and once those standards are established, and their value proven, I think more and more steel men will follow them.

Metal Spraying in Plant Maintenance

▲ IN reporting on the use of metal spraying in plant maintenance work, John O. Russ, Shop Foreman, Toledo Furnace Plant, Interlake Iron Company, Toledo, Ohio, states:

"Our most recent job was saving one of the yard crane armatures. The journal and taper were worn about 1/8 in. on the radius of the 2 in. diameter for approximately 14 in. This job was rather delicate inasmuch as the keyway also required a build-up. We plugged the keyway with a wooden key, and simply by running a nominal film of grease over the exposed top of the key, were able to remove it easily after spraying with 1.20 carbon steel.

Recently we installed in our No. 14 locomotive a 2½ in. diameter valve stem that was also sprayed with 1.20 carbon steel over 9 running inches. The required fill here was about an 1/8 in. overall. Due to a low spot where the packing had worn the stem, steam blew by resulting in loss of efficiency mechanically, plus interference with the engineer's vision.

We frequently build up coal car axle journals spraying Norway iron. It is a matter of interest here that no machining prior to or after spraying is required on this application. The axles are turned manually as they are at once cleaned and roughed with a flat file. Spraying is done also by hand. The journal is calipered while the metal is being applied. Inasmuch as our press is sufficiently powerful to press out any somewhat high dimensions, this is a simple job. The wheels normally press on at 60 tons. We have sprayed many of these journals in recent years. All are still giving service today.

Another routine application in our shops is the spraying of bronze on pump shafts. We also metallize turbine shafts.

Recently we took down a boiler feed pump that had been running on sprayed metal for over three years for 24 hours a day. No wear whatsoever was visible on the sprayed bearing.

In addition to furnishing power for our own requirements we supply considerable current to the city of Toledo. This particular pump is activated by a 275 hp motor and delivers 1500 gallons per minute. The steam turbine shaft in this unit also has been metallized for the same period and is practically vibrationless today. Another pump rod — 4 in. diameter sprayed with bronze for 10 in. has been turning at 850 rpm for about 4 years. This is a 15,000,000 gallon per day pump and also has operated a constant 24 hr per day.

A three inch inside bore (with key way) was sprayed well over three years ago on our forced draft fan in the cindering plant and is still giving perfect service. Two years ago we began building up quenching car motor housings. These are all in use today. Various boiler house fans are running on sprayed metal. These are 2 11/16 in. diameter and move at 1750 rpm."

From The Mogul Metallizer, July-August, 1944

MAINTENANCE OF *Locomotives* AND *Locomotive Cranes*

. . . . regular inspection of locomotives and locomotive cranes will benefit both the maintenance and transportation departments by eliminating major breakdowns . . . .

by F. C. Schoen, PLANT ENGINEER

THE MIDVALE COMPANY

NICETOWN, PHILADELPHIA, PENNSYLVANIA

▲ THIS paper is restricted to the smaller types of equipment with which the author is most familiar. Due to restrictions of extremely short radius curves and minimum clearance it has not been found practical in the writer's plant to use locomotives with a rigid wheelbase of over 8 ft for standard gauge and over 5 ft for 36 inch gauge.

The plant rail system under discussion has both standard and 36 in. gauge rail on the same set of crossties, which in the case of switches and frogs calls for somewhat special equipment. Due to the present operating schedules, all equipment, both standard and narrow is in continuous operation and for this reason the maintenance crews are set up to cover the full 24 hours of each day.

Locomotives and locomotive cranes are divided for the purpose of this discussion into two classes:

1. Steam powered.
2. Internal combustion engine powered.

This paper will deal first with steam powered equipment and second with the problems of the internal combustion equipment, each type being in general serviced by separate repair crews. As previously mentioned all maintenance crews are so scheduled that men are available twenty-four hours per day, so that a minimum of time is lost putting any piece of equipment back in service when removed due to a breakdown of any nature. It should be mentioned that on Sunday when plant operation is at its lowest, it is possible to bring a good portion of the locomotives to the repair shops for routine inspections and repairs.

We have only a very few rules which we attempt to enforce for steam power, and the first is not as much a rule as it is a standard operating practice in any shop, that is, maximum time between boiler washouts should be 30 days. A second rule not so generally followed is that the maximum time between short general inspection of running gear and accessories is 24 hours. We have found that operation of locomotives and cranes is somewhat slower between the hours of midnight and 8 A.M. so accordingly it is at this time that steam locomotives are brought to the shop and run over the pits for an inspection and any repairs found necessary. It is this inspection, generally averaging 30 minutes in length with the small repairs made, which has saved many hours loss of equipment due to major breakdowns and smashups. Locomotive cranes are also given a general inspection during this same time of day.

Since it is not practical within the limits of this paper to cover fully the detailed jobs of locomotive and crane maintenance, we will now mention briefly some of the things we have put into practice during the last 5 years which have been extremely valuable in conserving manpower and keeping equipment running.

The treatment of boiler feed water was not too easy a problem to work out, and even today is not 100 per cent satisfactory but results so far obtained justify continuance. The practice is for locomotives and cranes to take water from the general plant water system,

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and while there are several locations equipped for the purpose, it is much easier, especially in the case of locomotive cranes, to stop at the nearest fire plug and fill their tanks. For this reason treated water introduced directly into tanks was not considered the practical answer. It was then necessary to calculate the amount of water used on the average for each twenty-four hours of operation of each locomotive and locomotive crane and make up a treatment charge to be introduced into the raw water of the tank once or twice during this period. Admittedly this would raise the concentration of salts in the boiler too high during part of the day and it will be low during another period, but (and here is the part which is of value to us) we have reduced staybolt failure from an average of 5 and 6 per week per locomotive to 1 or 2 per month. Also, on locomotives with bad furnace sheets we have practically eliminated recurrence of cracks and bulges. On locomotive cranes with vertical fire tube boilers we have reduced tube repairs at the lower flue sheet by fifty percent. All of these savings have been a result of removal and elimination of heavy internal scale by properly controlling the chemicals introduced into the feedwater. Caution must be used, however, when using treatment. At the start, if the boiler has much scale, frequent washouts are necessary; once a week is not too often. Further, if there has been active corrosion on flues under the scale, tube failure will be high until all are replaced. It is also necessary that every boiler using treatment have a thorough blowdown every eight hours; if operating crews do not do it, the maintenance men will have to.

Another useful accessory we have installed on locomotive cranes has been a very small feed water injector. The boilers on the cranes in question are of such size that only one 1¼ in. injector is required. However, it was found that the minimum rate of feed was too high for continuous operation and consequently when the operator would put on his injector he would tend to lower the boiler steam pressure and he would then wait for the pressure to build back up before resuming work. Since installation of a ½ in. injector with a minimum feed rate of one gallon per minute, operators now make necessary rate adjustments, and with a good fire keep working steadily with little interruption due to swings of steam pressures. This is especially noticeable when the crane is doing magnet and bucket work. We believe the continuous although slow rate of boiler feed is definitely helpful in keeping this type of boiler in continuous service.

In general under the operating conditions with which this paper is concerned, a set of tires will average two years of total life before replacement, with one re-turning of the tread during that time. We do not know if this is a short or long life in comparison to that obtained elsewhere, but as a great many of our shifts are short runs, plus a very small amount of trackage without curves, we have a wearing away of tread next to the flange giving a definite double flange effect. The usual cast iron brake shoe does nothing to help this condition, so we have introduced a steel shoe braking on the flange and on the outer edge of the tread. This shoe tends to equalize the wear by cutting down on both flange and outside of tread. Records show that tread life has been increased from 6 months to 12 months before flanges are condemned due to height. This means only one shut down for turning the tire tread each year.We believe a good practice, where trackage has a large number of curves, is to turn locomotives around at frequent intervals to equalize flange wear on both sides.

Another item we will consider is driving boxes. These boxes or journals are of cast iron with a bronze crown brass or bearing. In locations with a large number of short radius curves, wear of driving box sides is quite heavy causing excessive lateral motion. By using 5/16 in. to ⅜ in. brass screws as anchors and babbitting the sides of the box it has been found that the life of a rebabbitted box is usually greater than the original cast iron. The saving here is only considered as the cost of a new driving box.

All of the equipment just mentioned is serviced and maintained by men who are trained mechanics and boilermakers. Any man of the group can do boiler work, injector work and running gear repairs, or make any mechanical repairs necessary on the cranes.

With the next group of equipment to be considered the repairmen are made up of men who are trained in electrical, internal combustion engines and the mechanical repairs peculiar to this type of locomotive. Here again the locomotives are both standard gauge and 36 in. gauge, while the types vary from straight mechanical drive, through hydraulic to electrical drive; the engines are both gasoline and diesel. Here, as with the steam powered equipment, regular schedules of maintenance and inspection are set up and adhered to with varying degrees of success.

As may be expected, the internal combustion locomotive with many more parts exposed is subject to troubles never experienced with steam power. A steel plant is dirty, while a gasoline or oil engine requires air for combustion, the crank case is ventilated and a radiator is necessary for cooling. Therefore, air filters must be used and kept in condition, and radiator cores must be clean to allow air to flow. As a result, a maximum time of two weeks is allowed between cleanings and this will vary according to the seasons. In the summer, our experience is that air intake filters must be cleaned once every week.

In general, inspections on these locomotives can be made without using a pit, such as daily checks on lubricating oil, batteries, compressors, etc., and they are accordingly made during shift change of the operating crews, taking only about 15 to 20 minutes per locomotive. Weekly inspection is made with the locomotive over the pit and it covers running gear, brakes, traction motors, transmissions, and complete lubrication.

A yearly inspection is made on all locomotives and cranes, consisting of, in the case of steam units, internal boiler inspection and hydrostatic tests, and with internal combustion equipment, air receiver tests, and complete test and inspection of electrical equipment. It is at this time, in the case of standard gauge locomotives, that Interstate Commerce Commission inspection is completed. The time of this shut down varies but can usually be completed in three days, if additional work such as re-turning of wheel or tire treads is not necessary.

It has been found necessary to shut down internal combustion engines every two years for a complete overhaul. This consists of engine rebuilds, inspection

and reconditioning of traction motors and generators, overhauling of transmissions and drives. This is a very necessary job and requires a minimum of 2 to 3 weeks time.

As with many plants, our power has been greatly increased during the last few years, and all of it is in constant demand. As a result of this increase our shop facilities which were originally arranged for a few locomotives are very heavily loaded. We have pits inside over which both standard and 36 in. gauge equipment may be serviced, as well as outdoor pits intended primarily for servicing travel gearing of locomotive cranes. The inside pits are fully equipped with lighting so arranged as to flood the under side of a locomotive, and also arranged with drainage and a sump at one end so that boiler washouts over the pit can be made. Portable work benches with flood lights are available so that tools and lights are at convenient working heights for internal combustion engines.

A portable steam-jenny has been found very useful for proper cleaning of entire locomotives, although care must be taken to see that all electrical equipment is properly protected during the cleaning operation.

An item not previously mentioned, and with which we must be concerned, is wrecks and smash ups. Maybe it is only our problem but from remarks heard here and there, I believe it to be a common ailment in steel mills, especially if a locomotive ventures near the stock yards. Most locomotives prefer to jump the track or break something if there is scrap on or between the rails. Our only suggestion is to have on hand an adequate stock of spare parts. In general less operating time is lost if a spare can be installed, rather than having to wait until a damaged or broken part is repaired. This, we feel, is also true in the case of locomotive cranes. If spares are carried for electric mill and shop cranes, spares are equally valuable for the locomotive crane.

In conclusion I cannot stress too greatly the fact, that regular and preferably daily inspections of locomotives and locomotive cranes will benefit not only the repair force, but also the transportation department, by eliminating costly and time consuming major breakdowns.

DISCUSSION

PRESENTED BY

L. F. COFFIN, Superintendent Mechanical Department, Bethlehem Steel Company, Sparrows Point, Baltimore, Maryland

H. C. JONES, Master Mechanic, Philadelphia, Bethlehem and New England Railroad Company, Bethlehem, Pennsylvania

F. C. SCHOEN, Plant Engineer, The Midvale Company, Nicetown, Philadelphia, Pennsylvania

HARVEY W. MILLER, Locomotive Crane Maintenance Foreman, Bethlehem Steel Company, Bethlehem, Pennsylvania

L. F. Coffin: I have one comment to make regarding blowdowns on standard gauge locomotives. You say they should be blown down every eight hours by the operating crews; if not, the maintenance men have to do it. Of course, in a large plant where the engine may be three miles away from headquarters, that is a rather difficult thing to control.

A number of years ago we were faced with that problem, even though we had properly treated water going to the engines at regular treatment stations. We installed a continuous blowdown system which was very simple and it has been very effective ever since. It merely consisted of a hardened disk in a union below the water column, with a small orifice in it large enough to pass through at the boiler pressure almost as much water as was required to be blown down continuously. That water passed out through the tender and through a coil which condensed the hot water and then discharged below the tender.

The size of the orifice was determined by taking total concentration of solids. We have an electrical conductivity meter which is used daily for testing the concentration of solids in the water in each locomotive boiler, and that will give an indication so that he can advise the engineer whether it is overblown or underblown. We have been able through the years to get the size of those orifices so nearly right that almost the right amount of water is continuously blown down.

H. C. Jones: We have practiced two or three things that increased tire and rail life. One was to press on our rolled steel wheels to give 53⅛ in. back to back. The second item is to take a monthly check on the flange thickness and height, and when we find the thickness is decreasing on one side we turn the truck around.

Then another operation, we found to be advantageous, is to use a Lidgerwood cutter to reduce flange height. We use a cemented carbide insert in the tool holder and cut the flange down by operating the diesel locomotive under its own power.

F. C. Schoen: I have had little experience with the swivel trucks because, due to the plant restrictions, we have to stay to the rigid wheel base locomotives. Turning the locomotive around has of course the same effect as turning your truck around, and that is a big aid in reducing wear which will give you thin flanges.

Harvey W. Miller: We use spring brakes which automatically set the brake rigging when the crane is not traveling or if the air line breaks. These springs set the brakes making it impossible to move the crane until the hand release brake at each end of the crane is tightened to release the spring pressure or until the air line is repaired.

Instead of using the air to apply the brakes we use the air to release the spring brakes when the crane is traveling. We use an eight inch brake cylinder for each truck with the springs fastened on the opposite side of each cylinder controlled by a fulcrum lever which is fastened on the bottom of the crane coupled up with the spring rod on one side and the air cylinder rod on the other side. To release the spring brakes we use a straight air valve in reach of the operator.

F. C. Schoen: The crane of which I am speaking is

of the same type you have. We happened to have purchased some cars for intraplant use and in this service brakes are not used. These cars had standard 12 in. cylinders which we removed and installed complete automatic brake rigging on each set of the crane trucks. We didn't have to go to a spring arrangement and we were able, by tying down the valve to get a quick release time. As I recall it, we got a release time of three seconds which was ample and fast enough for a get-away. With this set-up, we now have one cylinder with brake for each truck with standard railroad type braking cylinder with integral reservoir.

Saving

OXYGEN AND ACETYLENE

▲ HERE are a few ideas for saving oxygen and acetylene that have come from users, both large and small, in widely separated industries and localities and that have been proved in their shops.

One relatively small shop has effected considerable savings by delegating a "supervisor of gas consumption." This workman, chosen for his competency and for his popularity with his fellowworkers, checks twice each day throughout the shop for excessive oxygen pressures, the use of oversize tips and nozzles, and wastefully low cutting speeds. The blowpipe manufacturer's recommendations in these respects are the accepted guide.

Several plants have had great success with a program for the periodic testing of apparatus and equipment for leaks. Hose lines are tested daily in a water trough; blow-pipe and regulator valves and connections, weekly with soapy water.

In addition to the regular checking of apparatus, a large manufacturing concern conducts, under competent supervision, a monthly test of its oxygen and acetylene pipelines, manifolds, station valves, branch valves, shutoff valves, and hydraulic back-pressure valves.

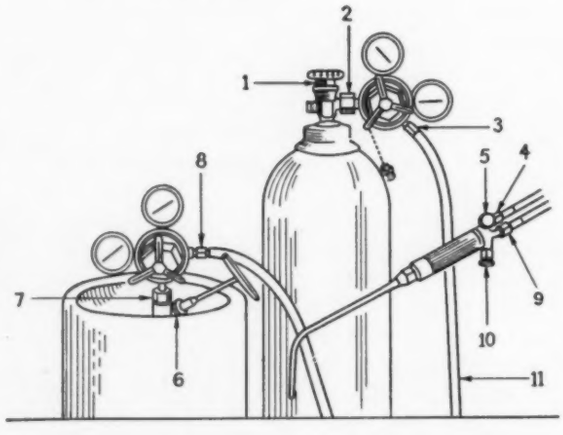
A busy war industry has found it profitable to send a man through the welding shops to see that all oxy-acetylene equipment is turned off during the lunch hour on each shift and to close master manifold valves during these periods.

Numerous shops have appointed one man in the tool crib to repair all leaks in hose lines, joints, and connections, and to renew worn packing in gland nuts on blowpipes and other equipment. In most cases, the same man who tests the apparatus for leaks makes the necessary repairs.

A walking apparatus repair man is the idea of a manufacturer employing hundreds of oxy-acetylene operators. He either makes the repair on the spot or hands the operator a reconditioned piece of apparatus and returns the damaged one to the storeroom. Only minor adjustments and repairs are attempted, however, since major or extensive repairs to oxy-acetylene apparatus are a job for the trained experts of the manufacturer.

A company that found it necessary to employ large numbers of inexperienced or newly trained operators discovered that their willingness to co-operate was not in itself sufficient to achieve the desired result in eliminating waste. An older employee in a supervisory position was appointed "conservation director." It is his duty to seek out and correct all causes of gas wastage, with particular emphasis on teaching new operators the most economical welding and cutting practices. This program, together with the prompt detection and repair of leaks, has resulted in considerable savings of both oxygen and acetylene for use elsewhere in war production. *From Oxy-Acetylene Tips, July, 1944.*

The eleven places where leaks are most likely to occur in the average welding or cutting outfits are shown in the sketch. They are: cylinder valves (1 and 6), regulator inlet connections (2 and 7), regulator outlet connections (3 and 8), blowpipe hose connections (4 and 9), blowpipe valves (5 and 10), and hose lines (11). Points 1 to 10 should be tested frequently by brushing on soapy water. Hose lines (11) should be submerged in water under working pressure.



STOCKING AND HANDLING

Raw Material

. . . . an efficient and effective set-up for handling raw materials must consider the nature and use of the material to be stocked, the location and extent of area available, the track system, type of cars used, and the equipment available . . . .

by J. T. Thomas, GENERAL FOREMAN

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▲ THE stocking of materials in any plant is of vital importance to the smooth flow of finished product from the plant or manufacturing unit. However, all too often this problem is solved not by careful consideration of all of the factors involved, but rather by some hit or miss method. This usually results in inefficient use of space, equipment and manpower.

It will be the purpose of this paper to attempt to develop the most expedient and economical methods of stocking materials, taking into consideration available stocking space, equipment, type and amount, method of loading and unloading, as well as the other important factors involved in material handling. Because of the variety and nature of items involved and all of the associated problems that are encountered, a steel plant forms an excellent background for this particular subject. We will therefore deal with the subject of material handling from the standpoint of a large steel plant.

Because this paper deals only with those items that are peculiar to the steel plant general yard department stocking, we will devote little attention to ore, coal or other such commodities that are handled in bulk by bridges, car dumpers, or other permanently established methods, and that have no influence on general yard department operations.

Steel plant operation, like that of any other manufacturing establishment, is dependent on an adequate supply of raw materials. It is of vital necessity to have available at a moment's notice all types and classes of stock, the absence of which would mean a shutting down of steel making operations.

The first consideration will concern the types and classes to be handled. Starting with raw materials we must consider coke, ore, limestone, dolomite, sand, clay, fluorspar, and the other miscellaneous groups.

Coke, both beehive and by-product, must be handled with extreme care to eliminate to the greatest possible extent the breaking up and disintegration to small sizes not suitable for use in the blast furnace, such as coke breeze. When produced in any quantity, coke breeze presents its own stocking problem.

The various iron ores that are used in a steel plant are a hardy group and need no special care in stocking. Limestone and dolomite do not deteriorate easily, but because both are used in the open hearth furnaces, they must be kept very clean and free of foreign matter. Sand clay, fluorspar, etc., present more of a material handling problem than any other type, since in localities where freezing weather occurs during the winter they must be stocked during the summer months for consumption throughout the entire year. This is necessary because during the winter months this material freezes in cars enroute to the plant and is very difficult, if not impossible, to handle in a frozen condition from any type of railroad cars to stock or to consumer use. This presents a problem that may become quite serious in case of a long cold spell if a number of carloads are involved, and may result in holding up railroad equipment with a resultant increase in demurrage, not to mention probable shortages at producing units. How-

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Figure 1 — View of a double track for handling scrap.

Figure 2 — Locomotive crane loading scrap into cars spotted on the adjacent track.

ever, if the material has been received and placed in stock during the summer, the surface of the stock piles may freeze, but the crust is easily broken and sufficient quantities that are not frozen may be loaded and sent to the consuming unit for immediate unloading.

The other class of materials, that is, the manufactured items, that must be stocked are considerably more numerous; they include brick, cement, fireclay and miscellaneous refractories, prepared steel scrap, unprepared steel and iron scrap, mill spare parts, salvaged material, lumber and special alloys for the various manufacturing processes.

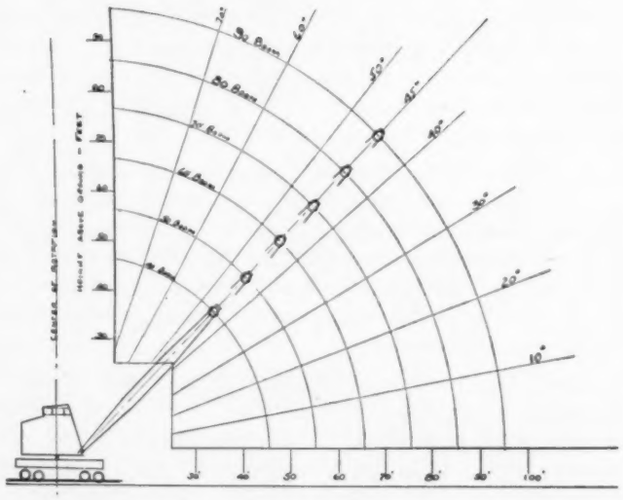
In preparing any stocking operation, there are two factors that must be given primary consideration: first, the amount to be stocked, and second, the speed at which it will have to be handled both to and from the stock piles.

Materials in general divide themselves into five groups. First, there are those that must be stocked or loaded rapidly. These are the materials that are in constant use in the plant in large quantities, and the stock piles are for the specific purpose of leveling out the inbound shipments to the point of having sufficient stock on hand with the smallest possible tie-up of railroad rolling equipment. Second are the materials that must be stocked in large quantities rapidly because of their nature or availability. Entire shiploads often must be stocked in a matter of a few hours. This type of commodity may be used in small quantities over a long period of time, or may be required in large quantities during off seasons. Third are those that are stocked over a long period of a few cars at a time, but due to their usage (sometimes large quantity shipment) must be available in volume on very short notice. The fourth are the items that pass through stock regardless of the usage demand. This includes materials which are unloaded into stock and loaded from stock usually into special type transferring equipment. The fifth class includes the material that is stocked for use at some future time, perhaps in a proposed future development, or it may be that it has considerable value but no immediate use due to special conditions that exist at the time.

After deciding into which group the material to be handled falls, it is then necessary to determine how it will be received and how it must be reshipped to the consuming units. Basically this resolves itself into the type of railroad equipment that will be used. The type of equipment is generally determined by the nature of the material or by the facilities at the consuming unit; for instance, a unit with a trestle and bins equipped to handle hopper cars of dolomite would be inoperative if the dolomite were received in gondola cars.

As an example, dolomite is in constant use in the steel plant in rather large quantities. Under ideal conditions it is received as it is needed for use at the rate of about 10 hopper cars per day. The stock pile is for the specific purpose of leveling out any irregularities of inbound shipments. If a railroad tie-up somewhere along the line causes a delay and no dolomite arrives at the plant, it is necessary to load dolomite from stock. When the tie-up or wreck has been cleared a large amount of dolomite will come to the plant at one time

Figure 3 — Chart showing the coverage of booms of various lengths.



and must be put into the stock pile in order to release the cars rapidly and to replace what has been removed during the shortage of shipments. Consequently the dolomite stock pile must be set up to handle dolomite either to or from hopper cars.

Upon reaching a decision as to the class of stock a material comes under and the type of cars that it will be shipped in, it is then necessary to decide what equipment is available to handle it, whether it must be handled by hand or whether it can be unloaded and loaded by locomotive crane, shovel, bulldozer, or other mechanical means. These facts are all pertinent to the final analysis and should influence, if not control, the decision as the method of handling the material. The final decision will govern the track arrangement, the space alloted, the equipment to be used, the personnel involved, etc.

At this point it would be well to digress for a moment and look at the possible track arrangements, because they are of the utmost importance and sometimes entirely control the stocking methods. When we consider that the cost of railroad track runs in the neighborhood of five dollars a running foot, and that under the present system of priorities it is very difficult to acquire in any quantity, this may well be a factor if not the controlling item in the establishment of any stock pile

Tracks may be laid out in any one of the following patterns depending on the material and the method to be used:

Two tracks running parallel on about 16 foot centers make the ideal set-up for handling stocks from gondola cars with locomotive cranes (Figure 1). The cars are spotted on one track and the locomotive crane operates on the adjacent track (Figure 2). This makes it possible to unload all of the cars on the track without the necessity of any shifting. The economy of this operation is of special importance in large plants where railroading facilities are controlled by independent units and a considerable amount of delay is usually experienced in waiting for the cars to be shifted. This results in idle locomotive crane time, as well as excess demurrage. With this type of operation all of the cars can be reached without adjusting the crane boom height and the pile can be put up higher, because the crane boom can be carried at a higher elevation. This is not possible when a locomotive crane has a car in front, since it is necessary to carry a very low boom in order to reach the end of a car away from the crane, and in some cases where cars are exceptionally long, 60 ft or over, it is necessary to shift the car out and turn it around to get all of the material unless exceptionally long booms are used (Figure 3). With long cars and a low boom, it is not possible to lift the material to any great height on a pile. If the boom is carried high except at the time it is used to reach the ends of cars, then a low place must be left in the pile and usually what happens is that the material from the ends of the cars finds itself on the tracks and has to be cleaned up at some later date. If this is not done promptly, the result is usually a derailment because of dirty tracks.

This double track method is especially recommended where large quantities must be handled rapidly. However, initial track expense and track maintenance should be considered before this type of layout is used. It would not be economical to install such an elaborate track layout for small amounts of material.

In stocking by the double track method, the two tracks may be maintained on ground elevation, or they may be elevated by using the material being handled as ballast where it can be done. This will, of course, get the maximum amount in the least space, because advantage is taken of the area that is used as a track bed (Figure 4). If large quantities of this type of material are to be stocked rapidly, then the most economical operation is to raise both tracks as the material is unloaded. This will make more space available and will put the greatest amount in the smallest possible area. In this type of operation, it is recommended that the tracks be raised during the unloading period, so that the piles on the outsides of the tracks do not become higher than the ties in the tracks. If the piles on the outside of the track become too high then the ties are covered and it is almost impossible to jack the track without pulling all of the ties loose.

Probably the best operation on a double track layout is to raise tracks when necessary during the day, using

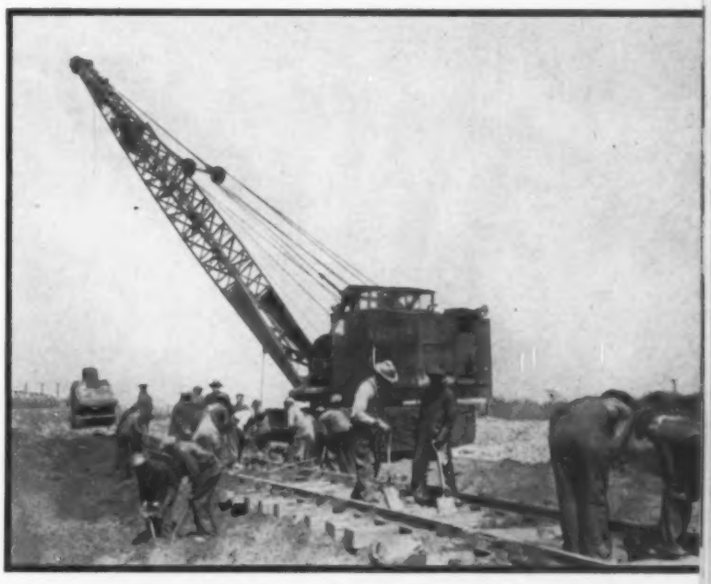


Figure 4 — Raising ore stocking tracks using ore as track ballast.

Figure 5 — Bulldozers piling stock material.

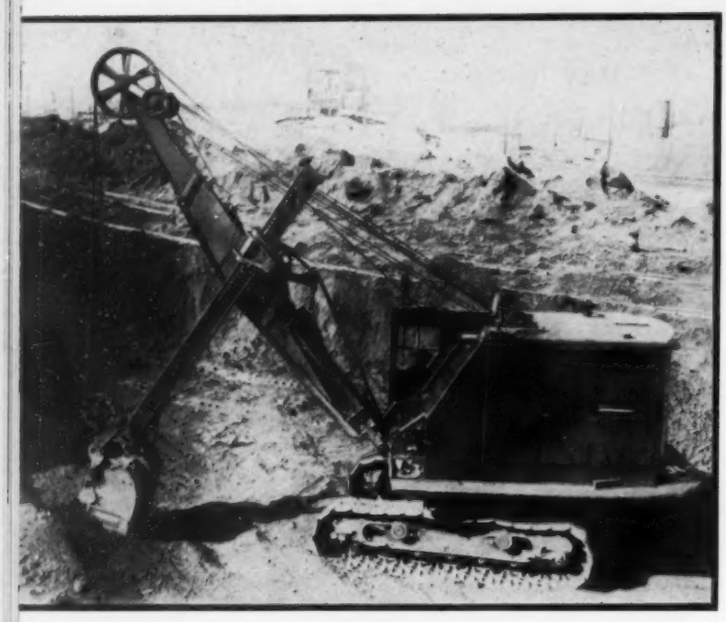


Figure 6 — Power shovel digging ore to load in cars. Note the elevated tracks.

a locomotive crane to fill in the track after it has been raised. This is faster and more economical than dragging hopper cars to fill the track. The track is then surfaced and used for the two night turns and raised again the following day.

The amount of raising that will be necessary, of course, depends on the amount of material that must be handled. Often a complete raise of 2 or 3 feet will be sufficient to last several days, and when this is the case time can usually be found between shipments to raise tracks so that there is no delay in the stocking operation. It facilitates matters considerably if the crane is always worked on the higher of the two tracks and the operations should be planned this way. The visibility of the cars and the material contained in them is better and the operation is easier for the crane operators. The only difficulty encountered with this operation is the fact that the bucket has a tendency to swing across the car, and this can easily be eliminated with a little skill by the operator.

After the tracks have reached a maximum elevation which may be determined by the ability of the locomotives available to place cars on the grade or by any of a number of items, the piles may at this time be carried as high as need be on either side of the track. In case all of the material cannot be placed on either side of the track, because of limitations of crane boom, etc., then bull-dozers may be used to move the material away from the tracks, to a distance, depending on the area available (Figure 5). Using this method with two diesel locomotive cranes equipped with 1½ cu yd buckets and sufficient bull-dozers to keep the ore cut back, it is possible to stock up to 5400 tons per 24 hour day. If bull-dozers are not on hand, the material may be placed as high as possible on one side of the tracks and the tracks thrown, as the pile becomes too high to be worked conveniently. Material (such as Lake ore) that is stocked in this manner usually is stocked during the summer when the lakes are open. This is piled for consumption in the steel plant during the winter.

This ore may be moved out of stock by any of several methods, the use of any of which depends upon the equipment available and the quantity and rate at which the materials must be handled.

It is possible by reversing the unloading procedure to load the ore in hopper or gondola cars with locomotive cranes. However, this method is not too efficient, because the ore compacts on standing and is rather hard to dig. The best method of loading is to use a power shovel. This may be operated on the ground level and may load directly into cars on the elevated track (Figure 6) or if the operation is large, a new track may be laid on the ground and the shovel worked against the pile and the track thrown as successive cuts are made. With this set-up, it is necessary to have a locomotive or some similar type of shifting power to move

Figure 7 — Another view of power shovel, loading ore into dump cars.

Figure 8 — Power shovel loading ore into 25 ton "carry-all" truck.

Figure 9 — Double track for stocking, with scrap on one side and dolomite on the other side.

Figure 10 — Coke stock pile with track trenched for the convenient unloading of hopper cars.

Figure 11 — Loading track on ground level alongside a high coke pile.

the cars past the shovel for loading (Figure 7). The type of cars loaded depends on the unloading facilities at the consuming unit.

Where engine power is limited or where cars are not available, the ore can be loaded in trucks or "carry-alls" and transported to the ore storage under the ore bridge or to a location convenient to the consuming unit (Figure 8).

In case of double tracks where there is no occasion to elevate either one or the other of the tracks, because stocking space eliminates this as a possible operation, or where different types of materials are to be handled on each track, the material generally is unloaded directly from the car with a locomotive crane and placed on either side of the track.

Where more than one material is to be stocked from the same set of tracks in this operation, it is suggested that, from the standpoint of orderliness and in order to reclaim all material, the types handled from either track be of an entirely different nature. With the crane working across the tracks there will be a certain amount of intermingling of the two materials especially in the area between the two tracks. An example of an excellent combination for this type operation would be rice dolomite on one track and scrap on the other track, since one is handled by magnet and the other by bucket (Figure 9). Regardless of the amount of mixing that takes place between these two materials, it is a simple procedure to separate them into their respective piles.

If the material to be stocked quickly in large amounts comes to the plant in hopper cars, it will make a double track set-up somewhat more difficult because nearly all standard railroad hopper cars contain reinforcing members that run longitudinally across the car, making it impossible to unload this type equipment with a bucket crane; these cars, therefore must be unloaded by hand.

In some of the very large plants car dumpers are set up for all types of cars, but since they come under the heading of permanent installations for handling large amounts of material they will not be treated in this paper.

A trestle is, of course, an ideal method of working hopper cars. The material can be moved from the bins under the trestle with a bull-dozer, bucket crane, overhead crane, or almost any of the well-known types of material handling equipment. However, trestles are expensive and often the operation does not make the use of a trestle possible.

Hopper cars may be conveniently handled if the track is elevated so that when the pockets on the cars are opened the material will run out with little or no assistance. In order to maintain the operation, it is necessary to continue to elevate the track as rapidly as the unloading progresses. After the stock has reached a maximum elevation consistant with the available area, or if it is no longer possible to elevate the track because of an excessive grade that cannot be negotiated by locomotives, it is then necessary to trench the sides of the track so that the material may still run freely from the cars (Figure 10). This is normally done with a locomotive crane and bucket which casts to one side of the track and piles to an elevation depending on the angle of repose of the stock being handled. Usually when the pile reaches a height of 20-25 ft, it will be impossible to keep a sufficient trench to contain the capacity of standard railroad cars. It is then necessary to throw the track away from the pile to a distance ranging up to 15 ft, depending on the nature of the material being handled. At this time a track should be

Figure 12 — Sand stocked on one side of a level track.

Figure 13 — Material stocked on both sides of a single level track.

laid on the ground level alongside of the pile on the high side, so that material needed from stock may be loaded with no interference with the unloading procedure (Figure 11). This is especially important where material is received in one type car, such as a hopper, and where it is needed for ultimate consumption in a department of the steel plant in some other type of car. Regardless of the nature of the cars to be loaded however, it is very advantageous to have this track on ground level, especially if the material must be handled rapidly. Locomotive crane operation will be much more efficient and safe, since cars will not have to be shifted on a grade and the crane will be working on level track. This set-up also lends itself very well to loading with a shovel. In order to conserve stocking space the normal procedure when unloading is to throw your high or elevated track in the direction away from the high pile that has been cut back. When loading, the low or ground track should be thrown toward this high pile. This means, of course, with excess unloading the pile will become wider and with excess loading it will become narrower. When the limit of the area has been reached by this method, the operation should be completely reversed. The tracks that have been on the ground should be elevated by means of unloading and raising and the high track should, at this time, be relaid alongside of the pile and the stocking area worked in the opposite direction.

Probably the most difficult and costly stocking operations are encountered when a small space and a single railroad track are available. There are several methods that may be used under these circumstances and it will be well to discuss these in some detail, because most stocking of materials (especially by the small plants) is done from a single track. This type of set-up is generally recommended where materials are handled to or from stock in small amounts, or when items are being stocked for future use. A single track may be used in any one of the methods described below.

First we will consider a single track with the stock piled on one side. This operation may be conveniently handled with a locomotive crane unloading a car and placing the material on the pile. It is often possible to stock several types or classes of commodities in different piles along the same track (Figure 12). If this be the case, care must be exercised to keep these separate. It will be well to note that either the cars loaded with material or the empty cars will have to be shifted by the crane in order to work this operation. It is usually more economical to have the loaded cars placed at the most convenient siding and shift them with the locomotive crane into position, unload them, and allow the empty car to stand along the pile. This leaves the car in position to be trimmed or cleaned out by hand labor.

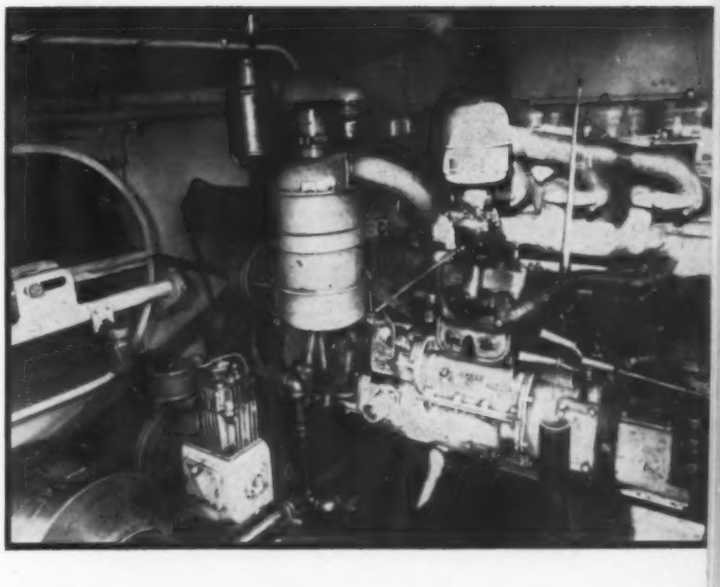
This type of operation also lends itself very well to handling with a crane that does not run on the railroad track. The cars may be spotted along the pile with a locomotive. A crane of the wheel or crawler type may move along the cars unloading them and placing the material on the pile. This necessitates leaving enough space between the track and the stock to accommodate the crane that is being used. Here again we should note

Figure 14 — Single track with trough for handling dump cars.

Figure 15—Handling scrap with a double track layout.(top)

Figure 16 — Interior of a diesel crane, showing engine and belt driven generator for magnet operation. (center)

Figure 17 — A 50 ton locomotive crane with a 105 ft boom and jib. (bottom)



that any material that is going to be handled with a bucket and crane should be ordered for delivery in gondola cars.

The second type of single track operation we will consider is similar to the first part of the double track procedure discussed previously, and is suitable for loading and unloading from either hopper or gondola cars. This is, of course, the single track which is elevated as the material is unloaded. It is necessary, if unloading from hoppers, to continue to elevate the track as rapidly as the material is unloaded, using the material itself as a ballast for the track. This operation will also allow the unloading of gondola cars as long as the track is not elevated too much.

The third type, that with the track on the level and the material stocked on either side can be used for either hoppers or gondolas, hoppers being unloaded by hand and gondolas with a crane and bucket (Figure 13). If hoppers are used, it will be necessary to cut back the material along the track on to a pile so that there will be room for the cars to be unloaded; with this operation, it will be found advantageous to use a trench along either side of the track. This facilitates the unloading in that the men do not have to shovel as high as they would if they started on a level area.

Any material that is received in the plant in hopper or gondola cars and is of such nature that it may be passed through the car dumper and placed in dump cars can be handled on a single track with a pit or trench alongside (Figure 14). This is by far the most economical method of stocking material. Stock can be dumped in the pit and cut back to the high pile at some later date with a locomotive crane. This eliminates all of the damage usually caused by working a bucket directly in a car, as well as the shifting of cars with locomotive cranes. A considerable saving of locomotive crane equipment is effected in this manner.

In handling the manufactured materials, completely different problems are encountered. Manufactured materials in general must be handled with special equipment and in many cases, because of the nature or the value of the stock, it is necessary that it be handled by hand. The largest material handling problem in this group is undoubtedly presented in the stocking of prepared scrap. This scrap must be stocked for use in the open hearth in case of scrap or pig-iron shortage, and must be available in large quantities upon short notice. The only track layouts applicable are the single or double type laid on the ground. Usually the nature of the operation and necessity of rapid loading and unloading make a double track layout necessary (Figure 15).

Scrap stocking is best done with an electro-magnet which requires electric current for its operation. Where scrap is stocked with locomotive cranes it is necessary

that a source of electric power be available, as well as cranes equipped with proper controls to operate a magnet.

We have found that supplying a source of electric power in conduits running alongside the track with the necessary outlets so that the magnet system on the crane may be plugged in at the desired point of use is rather expensive and quite difficult to maintain. In addition to this, stocking limits are entirely confined to the area supplied with electric energy. Moreover, the locomotive crane is rendered basically immobile, due to the wires running from it to the conduit, which must be connected and disconnected when the crane is moved any distance.

Steam-driven generators on steam operated locomotive cranes have proved to be uneconomical, because of the excessive water consumption of the boiler in generating sufficient steam to operate the crane and generator. A direct connected 15 kw generator, belt driven from the diesel engine on diesel locomotive cranes (Figure 16), has been found to be exceptionally satisfactory provided that the diesel engine has the capacity to operate both the crane and the generator, and is equipped with a sufficiently sensitive governor to maintain a reasonably constant speed-load curve. As the speed of the engine decreases under load, the resultant voltage drop in the generator, if at all excessive, will cause the magnet to drop its load. If this condition is guarded against by the use of sufficient engine power and a good governor, the resultant ability of the equipment to handle scrap or do other magnet work will be well worth the additional cost.

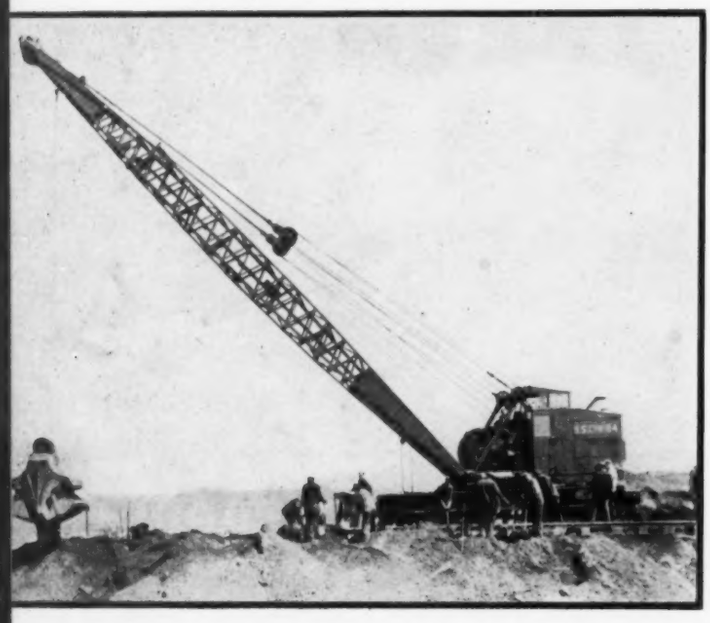


Figure 18 — Bucket with holding and closing cables dead-ended on the crane boom.

Figure 19 — Bulldozer grading large piles of plant refuse.

Having determined first the group into which the material that is to be stocked belongs and second the most convenient and economical track set-up, it is then necessary to consider the equipment that will be needed to handle the stock. This is exceedingly important because even the best track set-up will be of no value if the equipment suitable for the operation is not available.

In the large plant the crawler or locomotive crane is probably most often brought into use in the stocking of materials. For this reason it will be well to consider some of the necessary characteristics of this type of equipment. A locomotive crane is of course one that operates over railroad tracks. In order to be of value in the stocking operations that have been discussed it should have the following characteristics: It should be mobile so that it can travel from place to place rapidly. This is of special importance in the larger plants where operations may be located some distance apart and where travel from place to place will be a large item. The crane boom should be of sufficient length to perform the necessary operations, but should not be so long as to reduce the capacity of the crane below an effective operating level. The length of boom is of course entirely dependent on the operation. Often it will be found most advantageous to have a crane with a medium boom and sufficient inserts and end sections to make an extra long boom if operations are likely to demand this class of equipment (Figure 17).

From experience we have found that the most effective boom length for the general run of operations is 60 ft. This is long enough to reach the ends of the longer type railroad cars with a reasonable bucket and is still not too long to be awkward in traveling through the yard.

The capacity of the crane is of major importance because it will determine the size of bucket that can be handled, and this is an important factor in determining the speed and rapidity of material handling. A standard locomotive crane of 40 ton capacity is in general the most versatile and is recommended. With this size crane equipped with a 60 ft boom, a 1½ cu yd bucket can be used safely at practically any radius without the fear of upsetting the crane. Furthermore a crane of this capacity will handle most of the miscellaneous work found around the plant. For some very special jobs it may be necessary to have a lighter or heavier crane.

In our particular plant we have a total of 22 locomotive cranes. These are in the following sizes: Seven 25 ton cranes equipped with 50 foot booms, used for yard work with track gangs, riggers, etc., and for general block work of a light nature; six 30 ton cranes, two equipped with 50 foot booms, and four with 60 foot booms, used for bucket or magnet work in addition to the heavier block work; seven 40 ton cranes equipped with 60 foot booms that are used almost entirely for handling materials with buckets or magnets; and two 50 ton cranes, one with an extra long boom for steel erection, and one with a short boom used for clearing wrecks and break-downs. Of the above group, thirteen

Figure 20 — Small tractor equipped with scoop-loader.

Figure 21 — Small wheel crane which may be used for a wide range of light work.

have extensions for the booms so that the shortest boom available is 40 ft and the longest 105 ft.

Buckets for use on locomotive cranes vary considerably as to kinds, shapes, sizes, etc. There are single line, and double line, hard digging, rehandling, power wheel, lever arm, etc. Any of these will do a good job at some of the material handling, but it is very difficult — as a matter of fact, practically impossible — to find any one bucket that will suit all conditions. We have had rather good success with the double line bucket with the holding and closing cable dead-ended at the boom (Figure 18). This keeps the bucket from spinning and eliminates the tag line running back to some type of take-up mechanism. This mechanism usually gives considerable trouble. The double or two part holding and closing lines mean less operator fatigue with larger buckets because of the decreased braking effort necessary. The double line cuts hoisting speeds in half, but usually the operations are such that hoisting speeds do not control the capacity.

Electric lights on all locomotive or crawler cranes that operate at night are necessary both from a safety and operational standpoint. These can be operated by a generator used especially for this purpose. Both steam and diesel cranes lend themselves very well to such an installation.

In any plant handling large amounts of materials, bulldozers are a considerable asset if not a necessity. The size and type will of course vary with the operations. Grading (Figure 19) or piling materials, pushing material up to a track for loading, cleaning snow, and other such operations require a large size bull-dozer. This same equipment can be used for throwing railroad tracks when necessary. This method relocating of tracks by merely grading the area and then using the bull-dozer to push the track to the new location releases a considerable amount of men. The bull-dozer can push almost any length of track any distance, provided it is handled in small bites, pushing at about every other rail joint, and not pushing more than the track will stand without bending permanently.

Other types of bull-dozers (Figure 20) are applicable for loading and unloading around the plant, as well as grading and cleaning up plant areas.

Wheel cranes of small capacity (Figure 21) that can operate on plant roads are very valuable assets to any plant operation. They are usable for small wrecks and break-downs, as well as for the loading and unloading of materials.

Summing up what has been said, we must consider the material to be stocked, the location and extent of the area that is available, the track system, the nature and use of the material, the type of cars that must be handled, and the equipment on hand. With the above information properly applied, an efficient and effective stock handling set-up should result.

DISCUSSION

PRESENTED BY

GEORGE PFEFFER, Chief Electrician, Florence Pipe Foundry and Machine Company, Florence, New Jersey

J. W. THOMAS, General Foreman of General Labor, General Yard and Rigging, Bethlehem Steel Company, Sparrows Point, Baltimore, Maryland

W. C. SCHULZ, Superintendent Power and Maintenance, Bethlehem Steel Company, Steelton, Pennsylvania

F. C. SCHOEN, Plant Engineer, The Midvale Company, Nicetown, Philadelphia, Pennsylvania

W. R. YORKEY, District Manager, The Electric Controller and Manufacturing Company, New York, New York

L. F. COFFIN, Superintendent, Mechanical Department, Bethlehem Steel Company, Sparrows Point, Baltimore, Maryland

H. K. HARDCASTLE, District Manager, The Electric Controller and Manufacturing Company, Philadelphia, Pennsylvania

George Pfeffer: I would like to ask Mr. Thomas what type ofelectrical distribution he has for use on the steam crane, where he has no steam or diesel driven generator for the electric magnet.

J. W. Thomas: For the operation of steam cranes that are not equipped with electric generators, we run conduits along the stock tracks. About every 400 feet we have outlets that are encased in a large pipe set upright in the ground. This pipe has a hinged door so that the receptacle and its switch are kept dry. We carry the drag wire on the crane and plug it into the most convenient receptacle. There is an individual switch located at each of these outlets so that the power may be turned off when the connection is being made or broken. This is important in that it eliminates all possibility of flash. This system is quite satisfactory if the conduit is kept intact so that no moisture can enter.

W. C. Schulz: We, on our pig iron crane, put a power unit on the back of the steam crane tender to run the magnet. That works very well.

I would like to ask how much material is handled per hour. How much did you handle with the steam crane?

J. W. Thomas: With some types of ore we have found, especially if we run bull-dozers over it, that the pile consolidates considerably. When this happens it is too hard to dig with a locomotive crane, but not too hard to dig with a power shovel. We have loaded as high as 3600 tons in 24 hours with a 1¼ cu yd shovel.

W. C. Schulz: We pushed it back with bull-dozers and used a diesel crane on rehandling it, and we handled 200 tons an hour.

J. W. Thomas: That is a high average. What sized bucket did you use?

W. C. Schulz: I do not recall the bucket size. We pushed the ore with the bull-dozers to take off the top crust, as the ore had lain there about a year. With the top crust removed we had no difficulty handling the ore with brucket cranes.

J. W. Thomas: Of course the main trouble with any shovel operation, if you depend on railroad cars, is the shifting service — getting the cars past your shovel.

W. C. Schulz: We were very fortunate in that; we had a long double track — a string of 30 cars on the track and we'd run along with the crane and load everything with one shift.

F. C. Schoen: What would you say would be the best method of handling a stock yard with overhead traveling cranes, say for the open hearth? To stock all the material in it — if you have ample capacity — which would involve unloading, stocking and working from the stock pile back to the charging buggies, or to keep the track clear and load into the charging buggies?

J. W. Thomas: My experience along that line has been limited to our Sparrows Point plant. In general we find it more economical to schedule our scrap delivery as it will be consumed. This is then transferred directly into the charging buggies. The scrap that is piled outside is used to level out these deliveries; in other words, if there are too many inbound shipments, we put scrap into stock, or vice versa. The amount actually stored in the stock yards themselves, is very small — just enough for a short emergency.

W. R. Yorkey: I would like to ask Mr. Thomas something about lifting magnet operations. I think he said he found it most satisfactory with a 30 ton crane with 60 ft boom. Does he use 55 inch magnets, or does he use a 65 inch magnet, and if so, does he handle the magnet with a single line?

J. W. Thomas: In general we use the 65 in. magnets and reeve with a double line. If the double line is used it stops the magnet from spinning and we don't have trouble with the magnet wire getting fouled. Our biggest trouble on magnet operations, is to keep the electric wire and hoisting cable separate because either is poison to the other. If they short out, the hoisting cable is generally burned so that it must be replaced.

L. F. Coffin: Another interesting application for a bull-dozer is in connection with cleaning brickbats out of open hearth slag pockets during rebuilds. That takes a small sized bull-dozer, but it is quick and economical.

F. C. Schoen: When Mr. Thomas was giving his paper a couple things came to my mind. He spoke of cranes on grades, and so on. We have a similar problem in our plant. We have one crane equipped with pneumatic brakes, the balance of the cranes are steam. You can stop a steam crane — you just put it in gear and reverse the engine, if nothing else. But you can't stop a pneumatically operated crane if your air fails. Everything goes in neutral and away goes the crane. As to our thought on the problem, we rearranged our braking, and put triple valves on the cranes with the regular railroad type cylinders. We must apply air to release the brakes, and our braking cylinders have air reservoirs, so that with any failure of air, the brakes are automatically applied. It saved one runaway we know of. We think it is a valuable thing to have automatic brakes.

The other thing I noticed — our cranes run with booms from 45 to 60 feet in length. Our maintenance problems on the slew motion goes up according to the length of the booms. The longer the boom, the more trouble we have keeping clutches in operation and the more trouble we have with the slew pinions and gearing, because, while a good operator can gauge his slew and cut his power, thus drifting the magnet over the load, a poor operator plugs his reverse motion and that is very hard on clutches.

H. K. Hardcastle: I was interested in Mr. Thomas' remarks about maintaining voltage on a lifting magnet from generator connected to main power unit on a diesel operated crane. I noted his statement that with an accurate governor they could maintain the voltage during the different load conditions of the operation, and if practical, that is probably a very good solution.

However, there has been some difficulty with this arrangement and of course the difficulty is that when the crane starts to make the lift, the generator slows down, lowering the voltage on the magnet, then speeds up when lift is completed, raising the voltage.

Also, many of the crane operators will simply throw the controller off and then immediately throw it back on again, so the magnet instead of being on 50 per cent of the time is on 90 per cent of the time, and most of this at over-voltage. This over-voltage and excess time on causes overheating of the magnet and lower lifting capacity and probably higher maintenance.

Another solution is the use of a separate small gasoline driven generator. I believe there are a number available.

Maintenance -

A ROUND TABLE DISCUSSION

F. O. Schnure
ELECTRICAL SUPERINTENDENT
BETHLEHEM STEEL COMPANY
SPARROWS POINT, MARYLAND

M. B. Antrim
ASSISTANT TO ELECTRICAL SUPERINTENDENT
LUKENS STEEL COMPANY
COATESVILLE, PENNSYLVANIA

G. O. Van Artsdalen
MAINTENANCE SUPERINTENDENT
HENRY DISSTON & SONS, INC.
PHILADELPHIA, PENNSYLVANIA

J. C. Royston, MASTER MECHANIC
BLAST FURNACES AND COKE PLANT
BETHLEHEM STEEL COMPANY
SPARROWS POINT, MARYLAND

L. V. Black
ELECTRICAL SUPERINTENDENT
BETHLEHEM STEEL COMPANY
BETHLEHEM, PENNSYLVANIA

R. W. Couch
ASST. SUPERINTENDENT OF MAINTENANCE
BETHLEHEM STEEL COMPANY
EETHLEHEM, PENNSYLVANIA

SOME ITEMS OF *Electrical Maintenance*

by F. O. Schnure

▲ I would like to say just a word about relaying in its relation to maintenance. Some years ago I discussed pilot wire relaying of certain transmission lines in our plant, and I would like to state that it has proved very satisfactory. In several instances where locomotive cranes have swung into the lines the circuit has been cleared so quickly that only a few strands of the cable were burned. Also, during the last year or two, we have been putting current balance relays on our heavy rotating equipment with the same idea of taking them off the line when trouble begins to develop in the winding and before much damage has been done. On the same basis we have applied instantaneous elements to overload relays, so that in case of trouble, it is not necessary to wait for the time element of the ordinary relay to function; the instantaneous overload relays, of course, are set at a very high value.

Another point worthy of mention is the hardening of the ends of crane rails, which has proved a big factor in keeping the joints in good order. In making this statement, I appreciate the fact that thermit welding of rails is probably better, but in these days of high productivity it is very difficult to get the runways to do the job.

For years our repair shop has been experimenting in order to find a simple method of removing the old asbestos insulating tape from the strap copper winding in the conventional lifting magnet when the coil must be rewound. Laborious brushing and scraping seemed to be the most satisfactory method and in most cases the old coil was scrapped until the general foreman of our electrical repair shop hit on the following continuous process: The pancake to be rewound is mounted on a mandrel; the strap is then led through a bath of molten lead (spent babbit), which loosens the tape, then passed between two motor driven rotating wire brushes which cleans the strap. Next the strap is led through a tension device to the winding head where the asbestos insulating tape is wound on with the strap.

Presented before A. I. S. E. Philadelphia District Section Meeting, April 4, 1944

The addition of a helper to watch and assist in the cleaning process allows the winding of a pancake coil from old copper as expeditiously as from new. In these days of copper conservation the above method presents a substantial saving of labor and material.

AUTOMATIC RECORDING

Alarm Systems

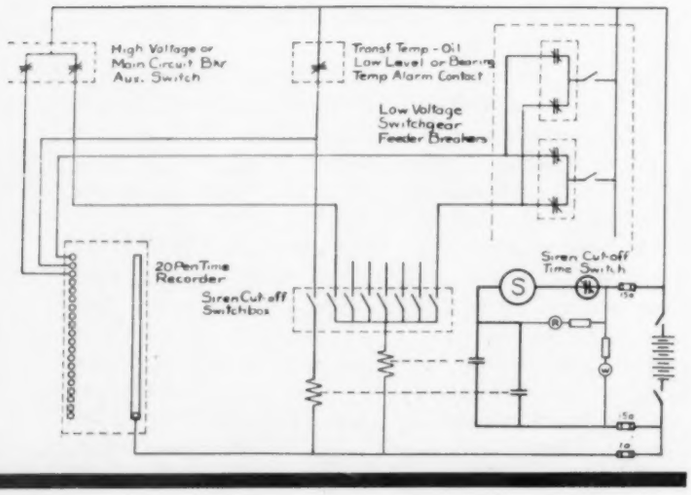
by M. B. Antrim

▲ IT is sometimes quite necessary that a record be kept of any troubles or interruptions in the service supply systems of a steel plant. Figure A illustrates a recording alarm system which can be applied to power, fuel, or water systems, although in the diagram it has been applied to an electric substation.

This system consists of two main devices, a recorder and a siren. The siren is an ordinary d-c battery operated unit. The recorder has a spring wound clock mechanism driving a paper chart on which rest twenty small inking pens. Each of these pens is mechanically connected to a small continuously rated solenoid which, when energized, causes the pen to move across the paper at right angles to the direction of movement of the paper chart, thus making it very simple to note which pen is operating. The pen will continue to mark in its new position as long as its coil remains energized. It is ordinarily necessary to use two normally closed contacts in an auxiliary switch attached to the device whose operation is to be recorded; however a single contact can be used with the addition of a small relay. Three connection examples are illustrated in the figure. The example in the upper left hand corner is a small two-contact auxiliary switch attached to any device whose operation is to be recorded as previously described. In the center of the illustration, a single contact auxiliary switch is utilized, while in the right hand corner a scheme is shown which connects a number of devices to a single pen in the recorder. The siren cut-off box is ordinarily locked and is only used to prevent the siren from operation in the event trouble occurs which will require some time to repair. The cut-off time switch will also stop the siren from operating, but it contains an escapement mechanism which causes it to automatically close its contacts after a predetermined time. You will note a small red pilot light is connected around the siren and cut-off time switch. This lamp will remain lighted in the event of an operation of the system even though the siren is stopped by the time switch. A small white pilot lamp indicates the presence of power to operate the system.

This alarm-recording system does not depend for its operation, on any power supply which might be interrupted, and therefore is highly reliable. This system has been installed in one of our electric substations and has proved very satisfactory.

Figure A — Battery-operated alarm system.



DEMAGNETIZING

Steel Products

by G. O. Van Artsdalen

▲ THE problems presented by magnetized steel and steel products have been prevalent in various degrees for many years. Many times finished steel products have been rejected at final inspection or by a customer because they were magnetized. Magnetization causes metal cutting tools such as milling saws, cold saws and machine files to retain the chips, which cling to the cutting edge, sometimes becoming imbedded, causing irregular cuts and frequently spoiling work where accurate cutting is desired. Many times bar stock to be machined, being magnetized, has presented a problem when being turned, threaded or filed in that the turnings and chips cling to the stock, frequently spoiling a tool or causing numerous rejects when inspected.

Theories as to the origin of residual magnetism in tools or stock are erratic and not always true. Much material is handled by lifting magnets, and claims that magnetism is retained from this source are sometimes substantiated. However, most of this material is reheated to from 1800-2200 F for rolling, which of course removes any inherent magnetism. A theory is also frequently advanced that materials become magnetized by impact such as received in a straightening machine, shearing or cold rolling, particularly if the axis of working lies in the earth's magnetic field lines.

Many steel products such as cutters or circular saws are surface ground on magnetic chucks, and may retain some magnetism when removed from the chuck. Frequently tools that are magnetized create a safety hazard such as was the case with a punch press used for tooth-

ing large band saws of 11 or 12 gauge thickness and 16 inches wide where the punch was magnetized, having become so by regular contact with magnetized stock. Frequently as a tooth was punched out the blank would cling to the punch on its return stroke and on the succeeding stroke would cause an irregular tooth or sometimes fly through the air with the speed of a shot when striking the die on the downward stroke.

It is a well known fact that certain alloy steels are highly susceptible to the influence of stray magnetic fields so that we are not usually too much concerned with the origin of the objectional magnetism as we are with the question of removing it and keeping it out. In the case of our products each inspection bench has been long provided with a 60 cycle demagnetizer which is simply a coil wound with a sufficient number of turns to operate continuously without undue heat and of a sufficient number of ampere turns to create the necessary alternating field strength, the opening through the coil being of such size as to accommodate a variety of sizes of products and the whole unit enclosed in a case to prevent mechanical damage to the winding.

In the case of the band saw toothing press a demagnetizer was provided for the punch and die to be used after same were ground and before they were placed in the press. Then a demagnetizing coil as previously described was placed at the side of the press where the stock entered, so that the stock passes through the demagnetizer before it reaches the punch. The hazard was completely eliminated.

As previously mentioned, the problem of demagnetizing products has been with us for many years but has always been overcome rather easily by the installation of a properly designed coil for 60 cycle operation. However, in recent months a special analysis of steel has been a part of our contribution to the war effort, this material being supplied by us in round, hardened, tempered and straightened stock to another manufacturer for further machining in turret lathes where extremely accurate turning and threading were required. No attention was paid to its state of magnetism as no mention of such was in evidence in the specifications. However, when the first lot was rejected because it could not be machined in its condition as received, it was at the time thought to be a simple matter to remove the magnetism and reship it. Such extreme self-confidence was decidedly misplaced, for after what was thought to be the proper coil was built and used, residual magnetism invariably returned five minutes after the bars were demagnetized. We found that the usual treatment was useless. Many interesting suggestions were discussed and some actually tried but none were successful in removing the magnetism for more than an hour. After repeated trials with 60 cycle coils it was decided to vary the frequency to try to arrive at the proper frequency to fit the particular analysis.

A journey was made to Bethlehem to observe the operation of a unit built there which was known to be successful with a similar analysis of steel. From data and information acquired, a unit was built which was simply a d-c to a-c converter, taking 220 volts direct current and converting it to low frequency alternating current. This unit was driven by a variable speed d-c gearmotor so that it would give from ¾ of a cycle to 2 cycles.

At the same time an unused d-c motor was pressed into service as an alternating current generator. It having originally been a 15 hp, 115 volt motor with four field coils; its commutator was removed, the midpoints of its armature winding were connected to two collector rings and the unit then driven at 150 rpm by a small a-c motor. As originally intended, this unit provided 5 cycle a-c at 10 volts and required the construction of a different type of demagnetizing coil than the previously mentioned unit.

Since by this time a large quantity of material was awaiting demagnetizing, both units were put into service with almost equal success. However, since the a-c generator required less maintenance, it has been found easily capable of taking care of all demagnetizing needs at the present time.

A good bit of thought was given to the design of a proper coil and it was realized that to get the greatest concentration of a-c flux the coil should be designed to barely accommodate the largest size bar, or about 3 inches in diameter, and since the average length of bar was 16 feet the coil was built so that at least half of the bar would be in the coil at a time. Many thousands of pounds have been shipped since these last methods have been applied but to date no further rejections have occurred because of residual magnetization.

Conveyor Belts

IN THE COKE PLANT

by J. C. Royston

▲ AS good conveyor belts are very hard to obtain at the present time due to a shortage of rubber, we have made some changes in our method of loading the belts which have prolonged the life of these belts to the extent that we have been able to carry tonnages two or more times that previously carried on these belts.

There have been two changes made that are outstanding in prolonging the life of these belts. Our coke wharf, from which we feed coke to a belt, was 24 in. higher than the belt line. This meant that coke dropped 24 in. as it was loaded on the belt. We raised this belt line 11 in., cutting fall of coke to 13 in. It is our observation that our belts wear out, not from conveying coke that is at rest on belt, but from the effect of coke striking the belt when it is loaded and the cutting down of the distance that coke fell from the wharf to the belt helps to prolong the life of rubber on belt.

The second move we made may seem a little radical and probably cannot be done on all conveyor belts, but we have been able to do it on our most important and expensive belts. By changing the angle of slope the last 24 in. on our coke wharf we feed coke on to the belt about 12 in. off center of the belt and the belt wears where coke hits it off center. When wear on the belt indicates that the rubber is worn down close to

the fabric, the belt is taken off and reeled up; the belt is turned and the part of the belt that is not worn is put next to the wharf, where coke falls on it, thereby getting double life out of the belt. We have not had any trouble trimming these belts, due to feeding off center, as our wharf is 120 ft long with skirt plates on each side.

An example of the benefits derived since these changes were made is shown on what is known as our "East A" coke conveyor belt. This belt is 42 in. wide x 925 ft long, and the best tonnage carried on this belt previous to making the changes described was 1,190,000 tons. The belt now in service since changes were made has carried 2,750,000 tons and the condition of the belt at present warrants belief that it will carry better than 3,000,000 tons.

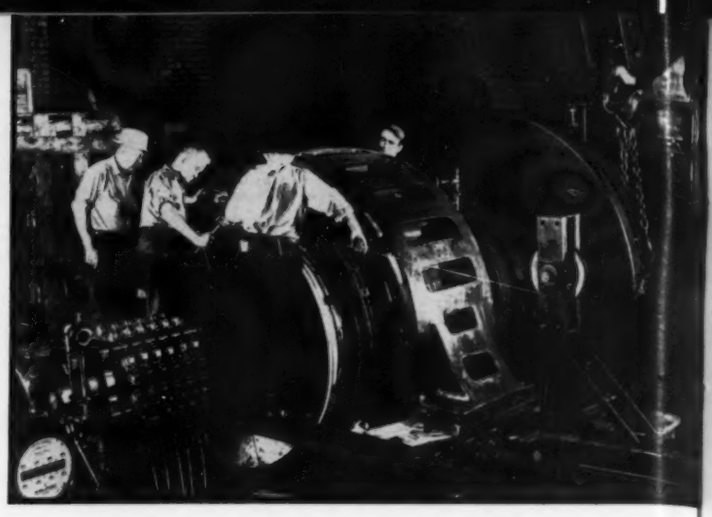


Figure B — View showing banding device in operation on large induction motor.

Rebanding

LARGE ARMATURES

by M. B. Antrim

▲ STEEL plant main drives have, for a large part, become electric; and although the maintenance of large electric motors is not a new story, one of our maintenance foremen built a device which may be of interest.

Replacing bands of large motor rotors, normally requires the use of tension blocks and associated equipment, as well as a method of turning the rotor. Tension blocks can be secured; however, when attempting to replace a rotor band on an armature in place in the motor, the method of turning the rotor becomes important, since to get a tight band, the rotor must not back up and slack off the tension on the wire being wound.

This device, however, eliminates the use of any tension blocks and also produces a tight band through the elimination of any possibility of slippage or variation in tension.

The motor pictured in Figure B is a 3750 hp, 2300 volt, 3-phase, 60 cycle, 500 rpm wound rotor induction motor, which is the main drive of the roughing stand of our new 120 in. plate mill. The diameter of the rotor is 62 in. and there are four double layer bands on this rotor, requiring 2600 ft of No. 12 steel banding wire.

You will note the banding device, made of structural shapes, consists of a rigid crank lever pivoted on a base. On one arm of the crank lever, a pulley has been mounted while the other arm is so constructed to allow the addition of weights. The pivot point of the crank arm is arranged to slide on the base and a chain block is attached to the pivot point for this purpose.

In operation, the base of the device is braced against the bedplate or foundation of the machine on which the band is to be wound. The other end of the base should be bolted or tied down to the floor. The band is then wound on the motor armature some distance toward the center of the motor from its desired location. The band should be wound as tightly as possible in this location with three or four extra turns included. Both ends of this temporary band are then clamped to the armature after one end has been threaded around the pulley as shown.

The pivot point of the banding device is then set to allow the crank lever to incline slightly toward the armature and after a suitable number of weights have been added to the horizontal lever arm, the armature is rotated in the opposite direction from which the temporary band was wound. In Figure B, a crane is used to rotate the armature; however, for smaller equipment, a bar could be used.

As the armature is rotated, the temporary band unwinds and the permanent band winds back on the armature. The first few turns should be wound between the temporary and permanent location of the bands as they will be loose. During these few turns it may be necessary to adjust the pivot point to take up slack or to increase the tension by adding more weight.

The band insulation and clips are then placed on the armature and the permanent band is wound. When the complete band is in place, it is soldered with its clips in the usual way, all temporary turns and the clamped wire ends are removed and the band is completed.

Since it does not matter how the motor armature is rotated as long as the banding wire may be guided to form a neat band, this device is very adaptable when no special banding equipment is on hand.

SAFE MAINTENANCE FOR *High Voltage Systems*

by L. V. Black

▲ REALIZING the dangers to personnel and equipment on any high voltage network, especially where the high tension system has grown to considerable pro-

portions with many ties to the utility company, it is important that circuits be operated with care and good judgment. Also realizing the vital necessity of clearing, shorting, and grounding high voltage lines or equipment before they can be worked on, we have set up a position of load dispatcher who must be contacted for approval before any switching or repairs can be made.

For any contemplated job the dispatcher plans the sequence of switching, and load redistribution; he issues permits to the foreman or leader in charge of the work to be performed; he directs the actual switching in transferring loads or in opening circuits; when the job is completed, the repair foreman clears the job with the dispatcher before any switching can be done; after which it is the dispatcher's responsibility to see that all lines and equipment are put back in normal operating condition.

Naturally the dispatcher must be thoroughly familiar with all power facilities and operating problems. The men to whom he can issue permits must be thoroughly familiar with their assignments. All men are not approved for all types of jobs. A record card tabulating the various types of jobs any man is approved to perform is filed with the dispatcher.

Permits are used to protect men. It is a printed form upon which is written specific information pertaining to the job, and is granted by the dispatcher after special precautions have been taken to protect the men doing the work.

Red tags are used to protect equipment and are attached to switches or controls that must not be operated. They are removed only by direction of the dispatcher after he has received a clearance from the man to whom the permit was originally issued.

Yellow tags are used to designate switches or controls that do not protect man or equipment, but the status of which is not to be changed without instructions or orders from the dispatcher.

For ground protection an approved short circuiting and grounding device must be applied ahead of the equipment or, in the case of high tension lines, on both sides of the section of line to be worked on before the job is started.

Responsibility is an important factor — the dispatcher must be responsible for all electrical and operating problems; he must be familiar with the work to be done and the protection required; he must arrange for and direct the application of the necessary protective measures, and clearly convey an explanation of the protection provided to the man receiving the permit. The man receiving the permit is responsible for making certain that sufficient and adequate protection has been provided; he is responsible for the safety of the men, for communicating and forwarding information to the dispatcher, for remaining on the job until the job is completed and for clearing with the dispatcher when the job is completed.

Normal jobs or repairs start with a job request and planning sheet, followed by a permit when the job is actually started. Breakdowns by-pass the job planning sheet, but must make use of the dispatcher, permit, and tags.

Periodic meetings of dispatchers, supervisors, foremen, and high voltage maintenance men are held to discuss past jobs, changes in the system, or new instructions. Through the use of load dispatchers, job planning, permits, tags, and continual education, there is little possibility of an error in providing the maximum protection for man and equipment.

AIR CONDITIONING ON *Pit Cranes*

by R. W. Couch

▲ ONE of the most abused pieces of equipment in the steel industry is a soaking pit crane when it is being used to make a soaking pit bottom. There has been much discussion about the practice of using cranes for this purpose. Convincing the operators that more care should be exercised when using cranes for this necessary work has also been a problem. Very little had been accomplished until about a year ago, when we placed a new soaking pit crane in service with an air conditioned cab for the comfort and protection of the operator.

The air conditioning unit is a mechanical refrigerating unit, electrically operated, and the unit is in turn cooled by an evaporative condenser and forced draft fan. In a test to see what the unit could do with an ambient temperature of 130 F, we found it possible to reduce the cab temperature to 75 F. During this test about 80 per cent of the air passing through the cab was recirculated.

The crane operators agreed on a cab temperature of 82 F and this was maintained throughout the summer. The air enters through a perforated ceiling and the temperature gradient ranges as high as 55 F to 90 F between the ceiling and floor. The operating cycle of the unit averaged about two minutes out of seven.

We have experienced no serious maintenance problems during our limited use of this air conditioning unit, and we feel that the investment has been worthwhile since we have eliminated the only reasonable excuse that could be offered for undue roughness in operating a soaking pit crane.

Power Limit Switches ON PIT CRANES

by M. B. Antrim

▲ IN connection with soaking pit cranes, we developed a crane limit switch application which might be of interest. These particular cranes are the cable hoist type, due to their 60 ton capacity and also because we

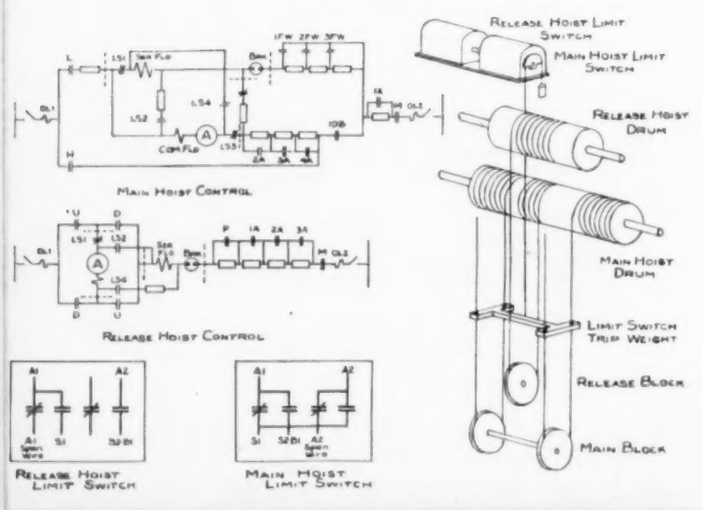
have not sufficient head room for the stiff leg type. Although this type of crane is not very prevalent, this power limit switch application can be used upon any similar mechanical motion.

The right hand side of Figure C shows the arrangement of the hoist of this type of crane. You will note the release hoist which is used to disengage the tongs, which are not shown, from an ingot has its own separate drive and drum. In addition, the other end of the release hoist cable is attached to the main hoist drum, since the release block must maintain a predetermined relative position to the main hoist block when the latter only is operated.

Originally, the main hoist only was equipped with a power limit switch. It was therefore possible, if the release block was above the main hoist block by a sufficient amount, to break the release hoist cables by running the main hoist up until the release block hit the bottom of the trolley. This would cause the release hoist block to fall off the crane if no tongs were attached, or in any case would cause a delay while new release hoist cables were installed. As the release hoist itself has no limit switch at all, the same result would occur if the release hoist was allowed to run up.

To remedy this condition, we took an additional power limit switch and coupled it mechanically to the main hoist limit switch. This new limit switch was placed in the motor circuit of the release hoist. The operating weight of the main hoist limit switch was then redesigned so that it would be operated by either the release or main blocks. Special attention was given to the new operating weight where it fits around the main hoist cables. For simplicity, the figure shows holes in the weight; however large "U" bolts were actually used and the whole device has proved very satisfactory. The left hand side of the figure shows the electrical hook-up used and as a matter of interest, although dynamic breaking is included in the release hoist schematic diagram, we found it was actually unnecessary, since the release hoist motion did not have sufficient inertia to drift even when operated without loa d

Figure C — Limit switch arrangement for pit crane.



ULTRA VIOLET RADIATION *Combats* ABSENTEEISM

by G. O. Van Artsdalen

▲ THIS discussion of the subject of ultra violet radiation is prepared, not to show the physical benefits received from a medical standpoint, but rather to describe a specific industrial installation, the reasons for making the installation, and its reception by employees for whose benefit the installation was made.

The plant physician had observed over a period of time traces of human fungi growth and other disorders which seemed to be mildly prevalent among men employed in the wet grinding rooms where the relative humidity was of the value of from 65-80 per cent due to the presence of large amounts of water necessary for the grinding operations. The men employed here have their hands and arms in water, or at least wet with water during their entire working shift. Most of them wear splash aprons and many wear rubberized leggings and clogs, some actually wearing rubber boots. The theory seemed to be borne out that certain physical disorders were peculiar to the men engaged in this work and based upon the experience of the physician in charge, ultra violet ray treatment was recommended for correction.

A study was made of two types of lamps, as well as of three methods of offering the treatment. The possibility of flooding the entire room with infra-red rays from numerous units was considered, where each man would be equipped with protective goggles, and at a previously arranged signal, each man was to put on his goggles, after which the infra-red units would be energized.

This plan was not considered practical for several reasons: first, the costs involved for an experiment of this nature were prohibitive; second, transient personnel would have to be barred from the area during treatment; and third, loss of time involved would be great and the benefits derived questionable, as most of the participants would hesitate to partially disrobe in the working area.

A second plan was considered, namely that of providing a booth type solarium, but was immediately abandoned as only one person could be treated per booth at a time, and the space involved for suffiicent booths to treat a large group was not available. The third plan to be considered, and finally accepted, was that of building a solarium capable of treating a group of men at a time.

Accordingly a fireproof, lightproof, and sightproof room, 18 feet square with a ceiling 12 feet high was built within the grinding room. This room is normally lighted by recessed fixtures using 200 watt Mazda lamps. Its floor is raised 14 inches above the grinding room floor and is of hard finish concrete, lending itself readily to

flushing down. Louvred openings are provided near the floor and a ventilating fan is installed in a small stack in the ceiling, providing a complete change of air once in five minutes. The infra-red unit provided is of the 360 degree type, being circular in shape, mounted on a 4 foot high pedestal and emitting ultra-violet radiation from a 700 watt quartz lamp. This unit with auxiliaries consumes 840 watts. It is installed in the center of the solarium and forms the center point of a 12 foot diameter circle which has been painted on the floor, this being determined as the proper distance from the lamp to stand to receive treatment. As the lamp requires a three minute warming up period, and frequent energizing and de-energizing is very detrimental to the lamp, a tubular heat-resisting shield has been provided with which to cover the lamp when groups of men are coming into or leaving the room.

Each man eligible for treatment is provided with a pair of goggles at no cost to him, which he keeps in his possession, thereby eliminating the possibility of transmitting eye infections from one to another by the use of the same goggles by different men. Since the room can accommodate 18 men around the 12 ft diameter circle, those to receive treatment were divided into groups of 18 and a reasonably accurate schedule set up so that the entire grinding room personnel can be treated in a minimum amount of time. Each group has a leader at the head whose duties are to assemble the group, unmask and mask the lamp and see that no delay is effected in disrobing and robing, keeping time to prevent a possible encroachment of the time allotted to the following group. A timer is provided, set to ring a warning bell after the proper time for treatment has elapsed.

The procedure for treatment is as follows: The group enters the room and the leader locks the door. One minute is allowed for disrobing, the extent of which being optional with the men. The group then forms around the 12 ft circle facing the lamp. Then the leader pushes a button which starts the timer, unmasking the lamp at the same time. When the bell rings, the group about faces, and the leader again pushes the time button, when the group receives the same length of treatment on their back that they have previously received on their front; immediately upon sounding of the bell a second time the leader masks the lamp and the group is allowed two minutes to dress. A total time of eleven minutes is required from the time a group enters the room until they are ready to leave.

Since this solarium has only been in operation a short time, no particular data relative to health improvement is yet available except claims by individuals, but the idea has been received with wide acclaim by the personnel and no man eligible to receive treatment has been known to voluntarily miss a treatment. At the present time treatment is given each man twice each week for a period of four minutes facing the lamp and four minutes with back to the lamp each treatment. First or second degree sunburn is produced each time, depending upon the sensitivity of the skin. Since the treatment is entirely voluntary and yet is taken by 100 per cent of the personnel eligible, and since insistent demands are constantly being made by a great number of other employees not now eligible it would seem that it will become necessary to install additional units in other parts of the plant sometime in the future.

DISCUSSION

PRESENTED BY

F. C. SCHOEN, Plant Engineer, The Midvale Company, Nicetown, Philadelphia, Pennsylvania

R. W. COUCH, Assistant Superintendent of Maintenance, Bethlehem Steel Company, Bethlehem, Pennsylvania

W. A. SMILEY, Assistant to Electrical Superintendent, Bethlehem Steel Company, Steelton, Pennsylvania

D. BRUCE JOHNSTON, Assistant to Research Director, Lukens Steel Company, Coatesville, Pennsylvania

G. O. VAN ARTSDALEN, Chief Electrician, Henry Disston and Sons, Inc., Tacony, Philadelphia, Pennsylvania

F. C. Schoen: I am curious to know what effect air conditioning of a crane cab has on visibility I am thinking of this from the standpoint of the ordinary traveling cranes in the shop. You have to close up the cab tightly and you are going to obstruct the operator's vision and he is not going to perform his job properly.

R. W. Couch: Closing this cab has curtailed a man's vision considerably. There is a door with glass in it to the right and to the left of the operator, a window in front and rear, and a heat resistant glass framed at an angle with the floor for vision below. The operator's view to the right and the left is limited and in order to get the signals from the heater and the other floor men, he must look through a window at his back.

I understand in some plants where they have air conditioning units on pit cranes, they have a communication system to keep in touch with the operator. In our plant, however, it is largely a matter of hand signals that govern what the operator is going to do, whether he is in a closed cab or in an open one, and he does have sufficient vision to see what he is doing down below and to see what is coming on either side. It doesn't curtail the vision as much as might be expected.

W. A. Smiley: In my opinion Mr. Couch has probably started something — something like the snow ball that ends up as an avalanche. Several years ago we installed an air-conditioned cab on a soaking pit crane, in an ambient temperature as high as 165 F. Since then we have had a veritable stream of requests to cool other crane cabs.

When we decided to install cab cooling, we inspected several installations using mechanical refrigeration, and decided to await further refinement and experience with these devices before installing one, and so instead chose cooling with ice. To do this, we insulated the cage and also the ice container to the maximum practical extent, and also made the crane cab as small as possible so as to minimize its heat absorption. Chilled water is circulated to the heat exchange unit in the cab. After a series of experiments lasting over a cooling season, we discontinued use of ice, having found that water alone was sufficient, if we limited the amount of incoming air to the irreducible minimum, and also cut off all air when the cage was over an open pit.

The main problem in this sort of job seems to be that of securing an economic balance between removal of

heat and preventing entrance of heat. I should like to ask what ambient temperatures were met on the air conditioning job described?

R. W. Couch: The ambient temperature in the building was around 130 F.

W. A. Smiley: We are interested in the evaporative condensers. Do you own a commercial unit?

R. W. Couch: It is a commercial unit.

W. A. Smiley: Did you take wet and dry bulb readings?

R. W. Couch: We took dry bulb readings. It's a return job; we recirculate practically all of the air, and above the perforated sheet on the cab of the crane the temperature was maintained at 55 F and the air left the cab at 90 F.

FIELD SERVICE DESIGN APPLICATION ENGINEER

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IMO PUMP DIVISION
of the De Laval Steam Turbine Company, Trenton, N. J.

W. A. Smiley: Did you insulate your cab?

R. W. Couch: This cab was furnished with good 1 in. insulating board in the wall.

W. A. Smiley: Did you make any attempt to prevent entrance of radiated heat to the cab?

R. W. Couch: No more than just closing the cab entirely.

W. A. Smiley: I might add that on the experimental job we did we found that shielding the radiated heat by placing a baffle below the crane cab does wonders.

R. W. Couch: There is a heavy mat of insulation beneath our cage.

W. A. Smiley: On this cab which was especially designed for the job, did you remove all heat producing controllers from the cab?

R. W. Couch: That is right. We only have the master controllers in the cab. The magnetic controls are installed in two fan cooled decks above the operator.

W. A. Smiley: Did you use double glass in the cab?

R. W. Couch: Single glass throughout. The efficiency could be stepped up considerably by providing baffles and using double glass.

W. A. Smiley: The reason I asked was that we used double glass of a type on which you could pour molten lead without breakage, and secured five times as much cooling as we thought we were going to get. We put four inches of insulation in the crane cab and we gave the operator a nice large rear view mirror so he doesn't have to turn around to see out.

D. Bruce Johnston: I was particularly interested in Mr. Van Artsdalen's remarks regarding the demagnetization of various alloy steels. In ordinary low carbon steel a 60 cycle field is adequate for demagnetizing purposes. Mr. Van Artsdalen stated that they found it necessary to go as low as ¾ of a cycle in order to demagnetize certain special alloy steels which his company is making. I would very much like to know to what extent the various alloying elements affect the capacity for magnetization, and how the correct number of cycles is determined in order to obtain complete demagnetization.

G. O. Van Artsdalen: Not being a metallurgist, I can't answer Mr. Johnston very readily. Much of the material that we had most of the difficulty with was a special bar stock, the analysis of which I can't say too much about.

We do find, however, that steels having a large percentage of either nickel or chrome, cause us the most trouble and are the ones that forced us to demagnetize with the lower frequency currents.

I mentioned the fact that hardened and tempered stock was the hardest to demagnetize as it seemed to obtain its magnetic properties by impact encountered in the straightening machine.

We likewise had some difficulty in using the low frequencies in that the tail end of the bars retained some magnetism as they emerged from the coil due to the slow reversal of polarity and the tendency of the bar to emerge at half cycle thereby becoming magnetized. This was overcome with the installation of a 60 cycle coil installed at the discharge end of the low frequency coil so that all bars must pass through it upon emerging from the low frequency coil.

MAINTENANCE OF

Oil Circuit Breakers

. . . . circuit breakers are the first line of defense of a power system . . . . preventive maintenance of breakers, by a rigid system of routine inspection, pays dividends in cost and in continuity of service . . . .

by E. C. Bruhns

COMMONWEALTH EDISON COMPANY

CHICAGO, ILLINOIS

▲ By way of introduction to the subject of the maintenance of oil circuit breakers, we should perhaps first discuss our various installations. On our system we have fifty-six types of breakers of various capacities, ranging from 440 volts to 132,000 volts, and from 300 to 4000 amperes, which require from 9 to 5295 gallons of oil for each three-pole breaker. These breakers are hand-operated, solenoid-operated, motor-operated, and pneumatically and hydraulically-operated. Many of these installations are arranged for phase isolation, with the mechanisms and oil tanks in separate rooms or on different floors, in fire-proof compartments.

We have what is known as the oil switch repair section. This section is in the construction department and is part of the station electrical division. It is charged with the responsibility of inspecting and maintaining all oil circuit breakers, together with other duties of a similar nature, such as maintaining high tension air circuit breakers, disconnect switches, and busses located in generating stations, substations and on outdoor transmission terminals. The men are skilled mechanics and especially trained for this work. They work on a prearranged schedule and are available twenty-four hours of the day. These men are constantly on the alert for hazards or defects where life or equipment is involved. Many serious cases of trouble have been avoided by inspections which discovered cracked insulators, loose connections, poor or pitted contacts, contaminated oil, faulty operating coils or tight mechanism parts which do not allow a switch to operate freely.

A regular external servicing of switches is made every six months in substations, distributing stations, and in transmission terminals at generating stations. Indoor mechanisms in generating stations are serviced every three months. The servicing includes cleaning, lubricating, inspection, and trial operations. Internal inspection depends on the number of operations. Switches on equipment such as rotary converters, condensers, rectifiers and daily operated switches are given semi-annual inspection, others at intervals from one to five years. All breakers opening on overload which show signs of distress, by the indication of throwing oil or heating, are inspected internally before they are returned to service, except in extreme emergencies when there is not time to do this. Then the inspection is made as soon thereafter as possible.

Our oil switch repair foremen do all of their own testing in connection with maintenance and repair of breakers. They determine whether the oil in the tanks is to be replaced. The quality of oil in switch tanks is determined by agitating the oil and inserting a special test lamp into the liquid. By this test cloudiness due to carbon deposits may be detected quite easily. If there is any doubt, the oil is replaced. All new oil is subjected to tests for dielectric strength and the presence of mineral acids, etc. Our containers used for storing or shipping oil require special handling to prevent contamination of the oil. The oil is delivered in cans, drums, or tank wagons, depending on the amount of oil re-

Presented before A. I. S. E. Chicago District Section Meeting, April 4, 1944.

quired for that job. Precautions are also taken to prevent the oil from contamination while it is being transferred to the switch tank.

One important job of this section is to check new oil switches during their installation. They are checked for accessibility for maintenance and to make certain that the proper tools and facilities are on hand for emergency repairs. Emergency repairs must be made in the shortest possible time. The essential repair parts and tools for maintaining small switches are carried on the truck with the crew. The larger tools and replacement parts are stored in the station where the switches are installed to eliminate any lost time in obtaining them.

The working equipment must be checked very carefully to prevent damage to the breakers while the adjustments are being made. In general, the facilities for this work include chain hoists, coffin hoists, dollies, gantry cranes, tractors, and portable pneumatic hoists for untanking. The accompanying illustrations show some of the equipment in the process of inspection.

One of our more recent developments in oil switch maintenance and safety is a split rubber sleeve which eliminates the insulating tape on high voltage terminals which have to be disconnected when truck-type breakers do not have special disconnect devices and removal of the switch is required for untanking. These rubber sleeves pay for themselves in a few inspections, as they eliminate the cost of labor and material to apply sixteen thicknesses of tape; you can readily see the savings over a period of time. Generally, these terminals are difficult to tape. This sleeve is used on voltages up to 12,000 and for inside use only.

We must bear in mind that individual pieces of equipment have become much larger, the electrical systems are becoming more complex, and load factors have improved, permitting fewer and shorter outages. The demand on manufacturers of war equipment has brought to bear considerable effort to reduce the amount of inspection and maintenance work, primarily because out-of-service time will not be available to follow our desired servicing schedules. If the allowable time for inspection and maintenance is reduced, we must be prepared for more emergency repair work. The aphorism "better care, less repair," is certainly true in the business of maintaining oil circuit breakers.

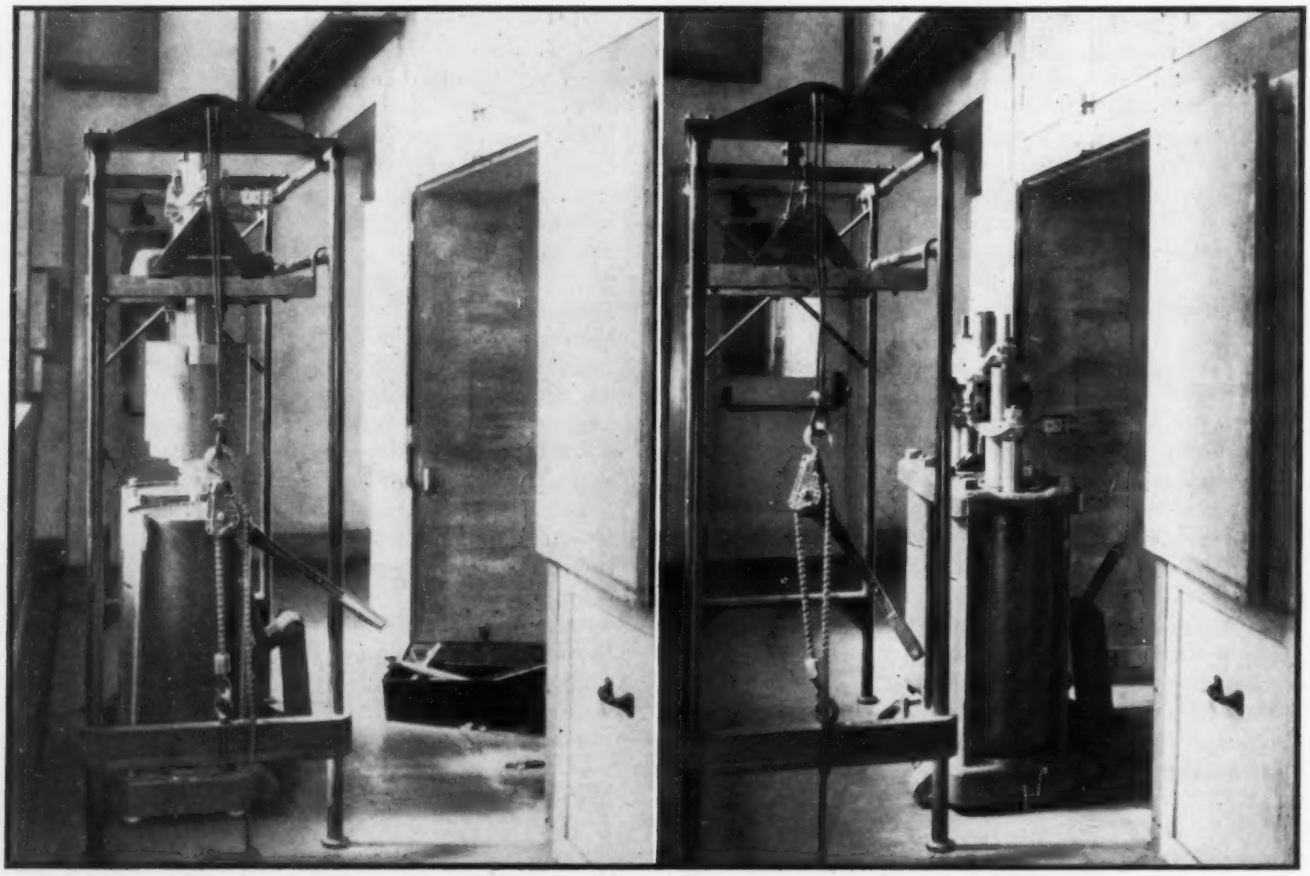
Let me quote from an article published in the January, 1944, issue of Electrical World:

"A short circuit occurring on the 11 kv bus recently at a hydrogenerating station of a large eastern utility company resulted in a four-hour interruption of service to part of its customers. Some industrial customers were also affected.

"About 8 p.m. the operator was removing a generator from service, when the oil switch of the unit failed to latch open and continued to close and open several times. This faulty operation continued until the switch

Figure 1 — Untanking device for FHD-17 breakers, showing switch open for inspection and temporary steel covers over tanks to prevent parts from falling into tank and damaging lower well insulators.

Figure 2 — Same untanking device shown in Figure 1, with assembled switch ready to be rolled back into compartment after inspection.



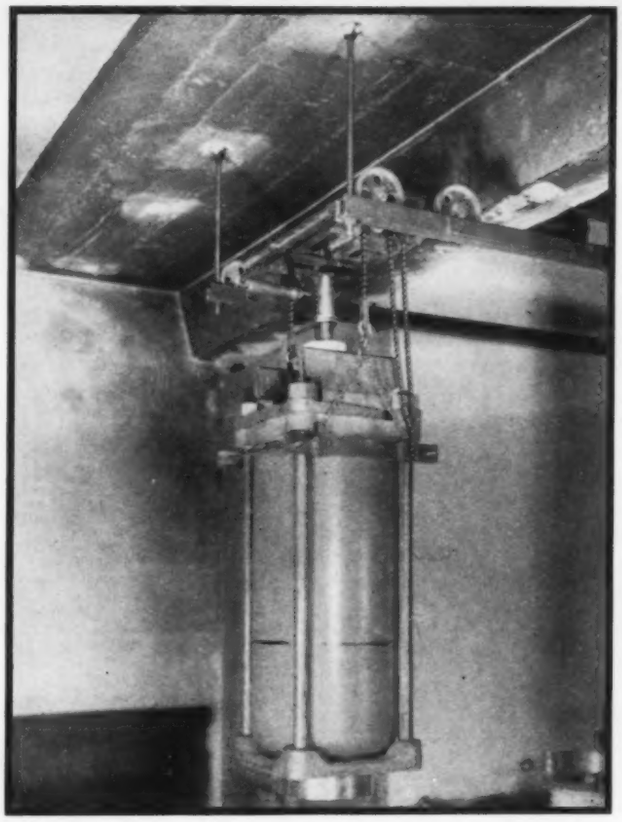


Figure 3 — Another type of untanking device using a traveling carriage running on angle tracks.

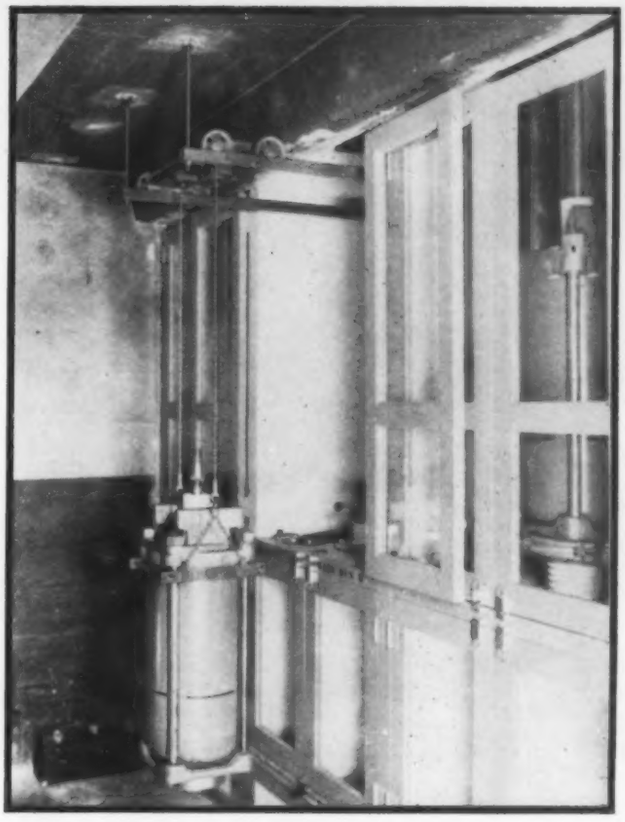


Figure 4 — Another view of the device shown in Figure 3, with switch being lowered preparatory to inspection.

was broken down, causing a short circuit. Several adjacent switches were affected and it became necessary to clear the entire bus. The faulty operation of the oil switch was found to have been caused by the fracture of a small pin in the operating mechanism.

"Damaged sections were isolated and full service restored shortly after one o'clock a.m. The damage was estimated to be approximately $35,000. There were no personal casualties."

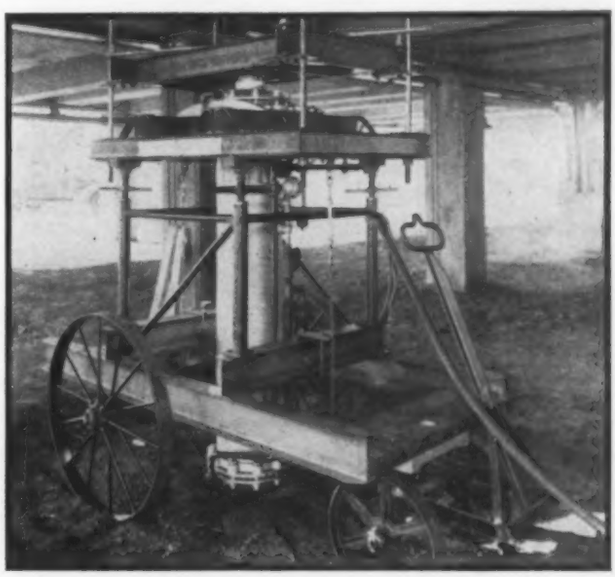
I cannot say whether this switch had regular inspection or not, from the facts presented, but maintenance — constant maintenance — is one of our most important duties. There is a good old saying that "A stitch in time saves nine", and a well organized maintenance crew will prove its worth any time. In this case, one small pin, one of the smallest parts, in the mechanism caused this damage which resulted in an expenditure of about $35,000.

Our circuit breakers are one of our first lines of defence. If trouble occurs in equipment they are protecting, the breaker must be on guard. We must take care of them and we must take care of the oil in them.

Our record is one of infrequent interruptions of service. This record has been made possible by a rigid system of routine inspections.

Just one more thought on oil circuit breakers. Records of all the unusual troubles encountered with our circuit breakers are furnished to our engineering department, which is responsible for the purchase of new equipment. Our engineers work with the manufacturers to correct and eliminate these troubles when new equipment is being designed, We are not satisfied only to repair the damage. That, of course, is our first concern, but our aim is to eliminate the cause of the damage. It is reports like these that the manufacturer wishes. If it were not for reports such as these, I doubt whether the progress in oil circuit breaker development would be as rapid as it has been.

Figure 5 — Portable pneumatic hoist for untanking 66 kv oil circuit breakers at outdoor transmission terminal.



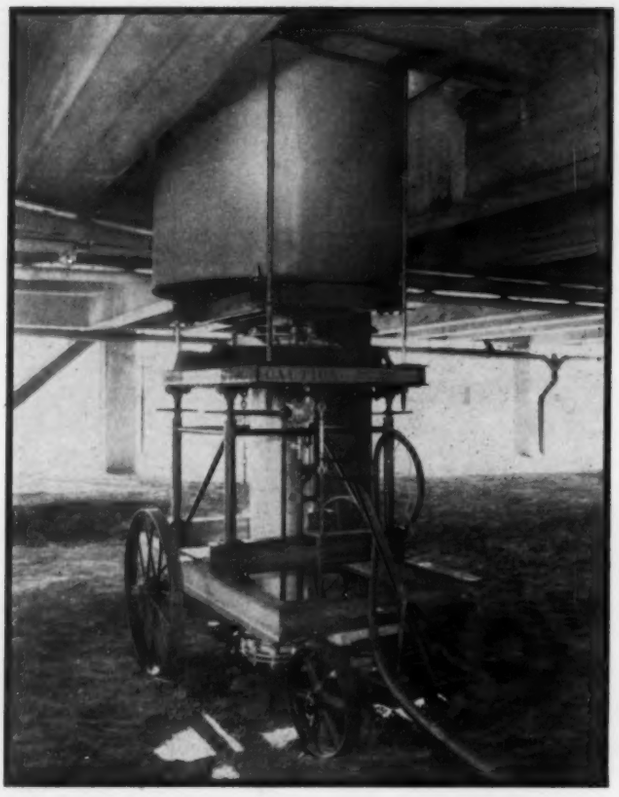
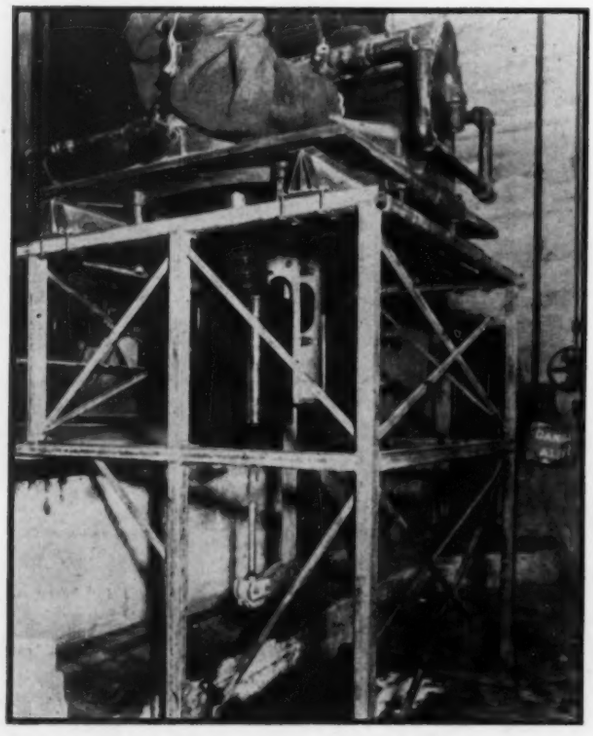


Figure 6 — Another view of portable pneumatic hoist, with tank being lowered through opening in platform above.

▲

Figure 7 — View of a 66 kv breaker untanked and mounted in special frame permitting access for inspection and adjustment.



We also have on our system numerous types of air circuit breakers which we use on various voltages up to 12,000. Space limitations make their description here impossible. However, breakers on 1500 volt d-c and high tension a-c between 2300 and 12,000 volts are inspected and maintained with the same regularity and by the same workmen who service our oil circuit breakers. The low voltage breakers are serviced by our operating employes whose duty it is to clean and lubricate the mechanism regularly, and when necessary to care for the contacts.

If heat causes excessive maintenance, the main contacts are silver plated by other workmen from another section of our station electrical division. We have found silver oxide improves the conductivity of the contacts and requires only wiping off with a dry cloth. This procedure has reduced our maintenance cost considerably.

Now, let us discuss for a moment a new development in the electrical field. Our experience with non-inflammable liquids is very limited, but I think it will be interesting and perhaps valuable for you to hear. This liquid is a patented synthetic insulating product known by a number of trade names adopted by the various manufacturers. It is not our practice to mix the liquids furnished by the different manufacturers, and under no circumstances should any of them be mixed with pure mineral insulating oil.

We use the liquid in some hand-operated disconnect switch boxes and some network transformers designed for our network system, the primary of which is 12,000 volts. Many precautions are taken to make certain the enclosures are air tight. The compartments are subjected to a 5 pound nitrogen pressure test. I understand that this non-inflammable liquid, to retain all its insulating qualities, must be kept free from air.

This liquid is tested at the time of installation, after it has been in service 3 months, and annually thereafter. It is tested for dielectric strength; also its power factor, and its acidity at various temperatures are deter mined. Under ordinary temperatures it is not dangerous for workmen to handle this liquid. However, care must be taken to avoid contact with the liquid because it is highly irritating to the skin. If the liquid is heated, it decomposes and emits a toxic gas which is disagreeable to inhale. The liquid has a strong solvent action on oils, paints, varnishes and other organic materials and it is easily contaminated by these substances. Our workmen are instructed carefully about the proper methods in handling. We use special working equipment for handling and testing.

We have two major cases of trouble on record with the use of non-inflammable liquid. One of these was apparently a case of grounding fault in a 12,000 volt switch box. We are not sure what happened inside of the switch box, but we do know that great gas pressure was built up, so great that it forced the liquid out of the switch box so that it covered the walls and floor of the transformer vault in which it was located. The disconnect switches and insulators were badly damaged, but there was no fire as might have resulted had the compartment been filled with oil. As I said, our experience with this liquid has been limited. Our first installation was made in 1939, but I expect more and more of these installations after the war.

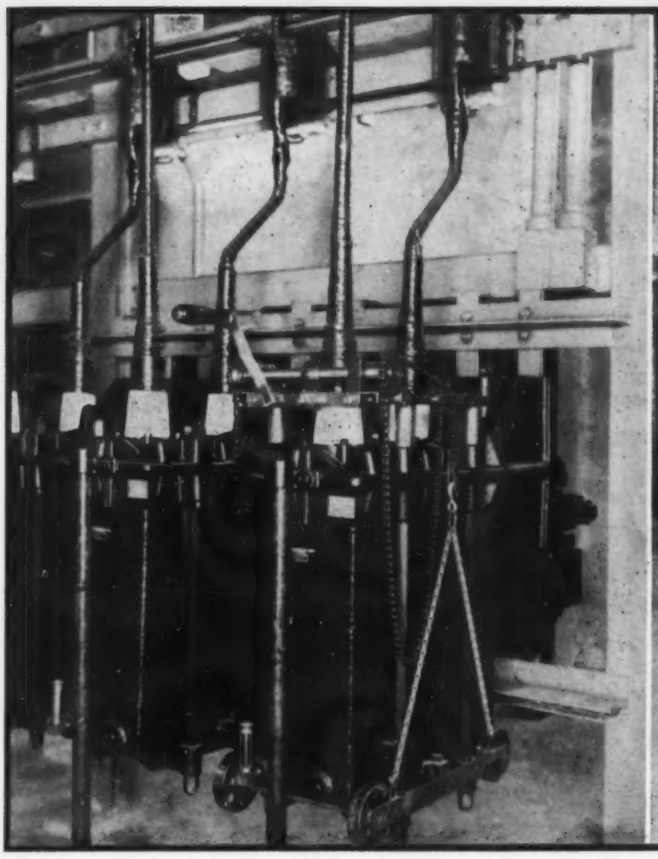


Figure 8 — Special untanking device for one type of breaker, showing installation ready for lowering.

Figure 9 — Another view of the device of Figure 8, showing switch tank lowered ready for switch inspection.

DISCUSSION

PRESENTED BY

A. R. DIBBEN, Assistant Electrical Superintendent, Youngstown Sheet and Tube Company, East Chicago, Indiana

E. C. BRUHNS, Commonwealth Edison Company, Chicago, Illinois

A. R. Dibben: I would like to ask Mr. Bruhns how many months before he makes an inspection and how often is the inspection made under a normal condition and who does the maintenance work on the switch — that is the inspection and the renewal of the different parts.

E. C. Bruhns: Our Oil Switch Maintenance Section makes all the necessary replacements, repairs and inspections; in fact, does all the caring for our oil circuit breakers.

A. R. Dibben: Your operators have nothing to do with that

E. C. Bruhns: Our operators are not permitted to perform any maintenance work on oil circuit breakers

A. R. Dibben: When the inspection is made under normal conditions, how often is that?

E. C. Bruhns: Our regular inspection schedules start with a six month period and increase to a year or more, governed by the importance and frequency of the operation of the switch. Upon every automatic operation of a switch where distress is apparent, either by the expulsion of oil or other evidence, internal inspection is made before the switch is returned to service. In extreme emergencies where continuity of service is important the switch may be returned to service without immediate inspection but the inspection is made at the earliest opportunity.

Air Conditioning

FOR CRANE CABS

. . . . air conditioning of cabs on hot metal cranes, pit cranes, etc. contributes to operator's efficiency . . . . conditioning units have been developed to a high degree of reliability . . . .

by J. L. Ferguson

ASSISTANT TO SUPERINTENDENT, RAIL MILLS

CARNEGIE-ILLINOIS STEEL CORPORATION

GARY, INDIANA

▲ AIR conditioning generally is understood to mean the simultaneous control of temperature, relative humidity, air motion, air distribution and ventilation within an enclosure. An air conditioning unit, to be successful, must exercise fairly accurate control of all of the above conditions. The absence of control on any one condition will result in a breakdown or failure of the system. Rapid change of temperature must be guarded against and relative humidity must be confined to a fairly close range. Air motion, air distribution and ventilation are equally important and consequently must receive their share of attention.

The air conditioning of hot metal and soaking pit crane cabs is a fairly recent development. While Gary Works has not pioneered air conditioning for hot metal cranes, we have been instrumental in developing several improvements. We, at Gary, were, I believe, the first to install any appreciable number of conditioners on ladle, hot metal and soaking pit cranes.

Soaking pit cranes proably offer most extreme operating conditions. This is particularly true on modern pit cranes with underslung cabs operating over soaking pits of large capacity. The operators on cranes of this type are located only a few feet from the top of the pits. The high ambient temperatures over the pits, coupled with radiant heat of approximately 2200 F, are a real test for any temperature reducing machine. Under these operating conditions the need for relief from heat is almost constant, and the machine must be designed and built not only to provide the wide temperature differential, but to withstand, without excessive maintenance, the constant pounding and vibrations of the trolley, hoist and bridge movements.

On soaking pit cranes the equipment is of necessity installed on the trolley. On the older type cranes the installations are usually more difficult to make and hard to maintain. There is very little room on the deck of the trolley and consequently some type of platform must be provided to support the unit. The cage is usually difficult to insulate and seal properly. This fact, coupled with the additional vibration of the hoist gears, ram and rack shaft, etc., creates an unsatisfactory condition and usually results in poor unit performance and high maintenance cost.

When buying new cranes or new cabs for old cranes, installation of air conditioning units can be materially facilitated by design of the cabs. The crane manufacturer should be provided with all information possible as to the size, weight, location, etc., of the unit. The location of the unit is important in that it should be shielded as much as possible from all radiant heat. The unit must be installed as close as possible to the cab, thereby cutting down the amount of duct or refrigerant line used and limiting as far as possible the air or refrigerant travel. Care should be taken to eliminate all vibrations possible, as excess vibration is apt to cause leakage in the gas or refrigeration system.

Presented before A. I. S. E. Chicago District Section Meeting, April 4, 1944.

Our experience indicates that to be successful an installation requires, in addition to a dependable unit, proper attention to cab and duct insulation. There cannot be enough stress placed on this important item. The cab and duct line must be provided with the best insulation obtainable. There are several good insulating materials available and it is essential that they be used. In practically all of our earlier installations we have found later a need for additional insulation.

We have now made it a policy in our division to insulate the cab on the inside of side walls and ceiling, as well as the floor. Insulation two inches thick and having a transfer coefficient of .33 or better is recommended. The same insulation should be applied to the air duct between the conditioning unit and the cab. We found, in tests conducted on a particular duct, a temperature loss of as much as twenty degrees through the duct when not properly insulated. Correct insulation reduces this loss to three degrees. The insulation can be covered with ¼ in. pressed composition to protect it and hold it in place. Loose type of insulation is not entirely satisfactory on the side walls and should not be used unless packed tightly to prevent settling.

The following is a recommendation by a unit manufacturer for cab and duct insulation:

The cab walls should have 2 in. rigid insulating board, faced with ¼ in. pressed composition. Cab floor insulation must be a minimum of 2 in. in thickness. Duct should include insulation 2 in. thick. Insulation, if placed inside of metal housing (16 gage or heavier), should be faced with ¼ in. pressed composition board. If the cab and duct are properly insulated and ceiled the cycle of operation of the unit will be substantially reduced. If the insulation is neglected the efficiency of the system is impaired and the results will be far from satisfactory. The unit will be forced to operate continuously in an unsuccessful attempt to reduce the cab temperature to a comfortable working range. This condition naturally will result in poor unit performance and high maintenance cost.

Double windows can be applied where vision requirements demand large windows, such as on soaking pit cranes. Heat resisting glass should be used and glass panels kept fairly small to make replacement inexpensive. Frames should be arranged for cleaning from the cab, so that the operator can easily maintain good vision at all times.

Temperatures to be held in the cab range from 85 F to 90 F, with a relative humidity within the recognized comfort range of 30 to 50 per cent. High humidities at this temperature are far from comfortable to the average human, and little cooling effect is obtained.

During the summer months, a man exposed to temperatures much below 85 F will, on leaving the mill after a day's work, experience temperature shock, the severity depending on the outside temperature and the general state of his health.

We have all probably experienced the effects of too low a temperature in movie theatres and restaurants where it is allowed to run more than ten degrees below outside, and it is generally recognized that a differential of seven to eight degrees is most satisfactory.

The self-contained units as used in the Gary Steel Works depend on cooling of 100 per cent outside air and discharging it into the operator's cab through an insulated duct line. However, some manufacturers recommend a slight modification of this principle where the refrigerant is transferred from the compressor, located on the trolley deck, into a cooler located in the cab, with recirculated and make-up air blown through the coils and being discharged into the cab.

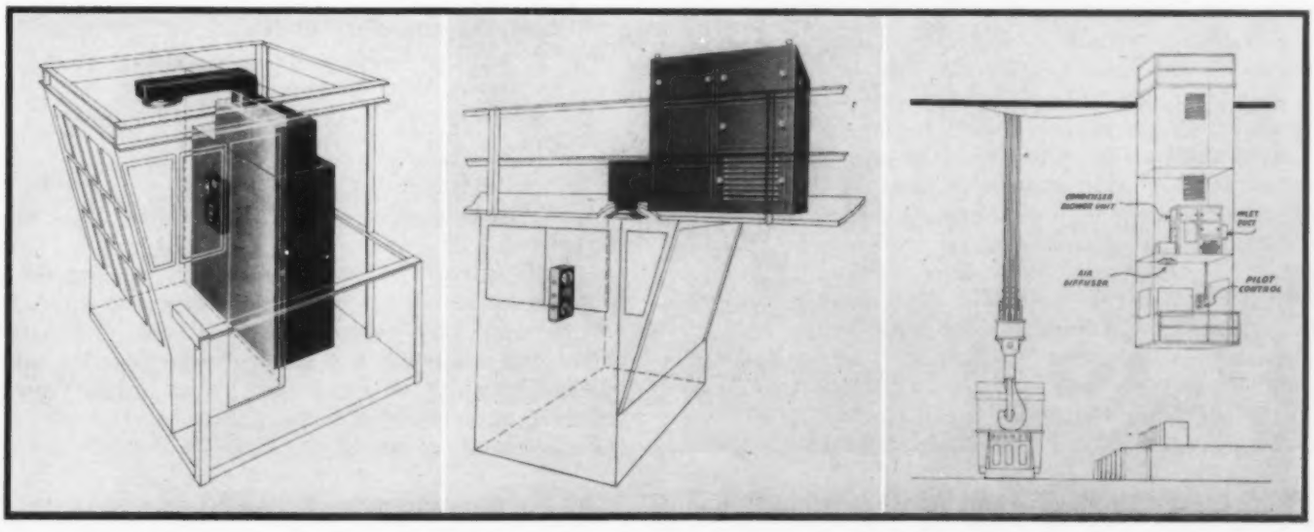
The self-contained units maintain a constant delivery of outside air to the cab. In this way body odors are quickly removed from the small enclosed space. This constant air change is also desirable where toxic gases are prevalent. A slight outward pressure is maintained in the enclosed cab to prevent infiltration and build-up of dangerous gas concentrations over a period of time. The usual industrial gases may be removed by use of an activated carbon filter, with the exception of CO. As this is only present in low concentrations at any one time, the constant air change prevents it from building up in the cab.

Delivery of 100 per cent new air to the cab has an added effect in the small enclosed space. Proper diffusion

Figure 1 — Sketch showing application of air conditioning unit on the crane cab.

Figure 2 — The air conditioning unit can be placed on the footwalk of the crane, as illustrated here.

Figure 3 — In multiple deck cranes the air conditioning unit may be placed on the deck above the operator's cab.



of entering air at a relatively high velocity gives a man-cooling effect that, with a comfortable relative humidity, results in an effective temperature well within the established comfort range for this type of work.

To make the unit usable on some cranes throughout the year, an electric heater is an important part of crane cab conditioning equipment. When gases and smoke, as well as dirt are to be filtered from the air, a heater is necessary.

All steel mill applications require mechanical filters, not only for the air entering the cab, but also the air used to ventilate the working mechanism. This is important if efficiency is to be maintained and the life of the unit extended.

We have found the permanent or screen type filter the most practical. It has a definite dust holding capacity before air flow is restricted; however, it must be cleaned at intervals. The interval between cleanings depends, of course, on the dust conditions. The throw-away type of filter catches dirt until it is loaded, and after that time a certain amount of dirt passes through without restriction. It is well to extend the life between cleanings by protecting the filters with louver openings, against falling dirt.

Activated carbon as employed in some equipment will adsorb up to 25 per cent of its own weight in gases. We understand this filter is being used with satisfactory results in several applications where extremely heavy concentrations of SO_2 are prevalent, as on nickel converter cranes. It is arranged in trays, easily serviced, and the cost of replacement is reasonable. The length of life depends on concentration of gases in the atmosphere. Where heavy smoke and vapors are present an electrostatic filter, in addition to the mechanical and activated carbon filter, may be used. This filter is utilized principally to pick up the smoke and vapors, as well as the extremely fine particles of dirt. Such applications are advantageous in forge shops and foundries.

Our experience indicates that, as is usually the case, equipment that may have proven satisfactory in commercial or light manufacturing installations is not rugged enough or oversize enough for the demands of every day steel mill conditions. This was true of the first air conditioning installations we made. Through experience, working with us, and specialization in this field, the manufacturer has done much to eliminate the cause of troubles such as breaking refrigeration lines, water splash, bearing failures, pump failures, electrical failures, and excessive head pressures. Please do not misunderstand or misinterpret this statement, While many of the attendant ills of air conditioning have improved, the units still require considerable attention.

We have found, to our satisfaction at least, that the conditioning mechanism should be contained in one unit, compact in size. It should be arranged for easy inspection. On most cranes, it must be installed in cramped quarters, on a platform, on the footwalk or in a compartment. Panels must be removable and easily attached when the inspection is completed.

Where there are a number of installations operating in the same mill, a spare unit should be kept available, so that when more than routine checking is needed a unit can be removed from the crane and the spare located in its place. The unit removed from the crane can then be repaired in the shop and held for application when needed. Necessarily then, the equipment must be arranged for quick removal from the crane. Air duct connections, wiring and water lines must be arranged for an easy disconnect. In most mills the operating department will not allow the crane to be held up for any appreciable length of time. If the installation is properly made, long delays are not necessary.

The controls used should be of heavy duty mill type, mounted in dust tight cabinets. Motors should be of the roller bearing type.

Preventive maintenance, as with other equipment, can forestall major repairs. With the newer design, we check twice weekly the filter condition, compressor belts, pump belts, oil level of compressor, motor and pump lubrication, motor operation, and note whether head and suction pressures are satisfactory. Service requirements will vary depending on the severity of the service, and as I have pointed out, soaking pit crane operation is necessarily the toughest assignment encountered by any air conditioning equipment.

Our experience leads me to state that air conditioning of crane cabs may be accomplished where heat and atmospheric conditions demand purification and cooling of the air. As stated before, considerable attention must be given to assure that the unit is installed in such manner that all parts are readily accessible to maintenance men. Also a program of preventive maintenance should be instituted and maintained to insure continuity of satisfactory unit performance.

DISCUSSION

PRESENTED BY

A. R. DIBBEN, Assistant Electrical Superintendent, Youngstown Sheet and Tube Company, East Chicago, Indiana

J. L. FERGUSON, Assistant to Superintendent, Rail Mill, Carnegie-Illinois Steel Corporation, Gary, Indiana

F. J. WOOD, Chief Engineer, Industrial Manufacturing Division, Goodman Manufacturing Company, Chicago, Illinois

ARTHUR HJORTSBERG, Division Superintendent Central Mills, Carnegie-Illinois Steel Corporation, Gary, Indiana

J. H. MILLER, Electrical Engineer, International Harvester Company, Wisconsin Steel Works, South Chicago, Illinois

R. R. STEINMETZ, Engineer, Eagle Picher Lead Company, Chicago, Illinois

F. E. KELLY, Electrical Foreman, Inland Steel Company, East Chicago, Indiana

W. A. LINTERN, The Lintern Corporation, Berea, Ohio

A. R. Dibben: How is the visibility with all the cab windows closed?

J. L. Ferguson: On the soaking pit crane, we use a heat resistant glass in the floor of the cage, which is only a small glass, approximately sixteen in. square, and that is removable and can be cleaned. On the side windows of a cab, we clean them by an ordinary procedure — any method of washing them.

F. J. Wood: I would like to ask if there has been

anything used in crane cabs along the lines of insulating glass.

J. L. Ferguson: I am not familiar with the type of glass Mr. Wood mentioned. It seems to me it would be practical and possible. However, we are using a tinted glass that is heat resistant — that is, it will not check or shatter because of heat.

Arthur Hjortsberg: It so happens that during last summer, it was my misfortune to have to listen to numerous complaints concerning the air conditioning units. The operators claimed that the units broke down too often; the maintenance man insisted that this was due to the fact the operator left the cab door open. Now, couldn't the maintenance man get the better of the operators by making up the units in such a way that they would not operate except when the cab door was closed.

J. L. Ferguson: It is possible that the unit could be interconnected or interlocked with the cab door so that when the door was opened the unit would not operate. I hardly think that would be practical.

J. H. Miller: I would like to ask Mr. Ferguson a question. He mentioned in his talk the employees' efficiency. I wonder if they have any figures to show that the employees' efficiency was increased?

J. L. Ferguson: No, we do not have it in figures, but I believe that is self-evident. Where you have a man working in a comfortable location and where he is getting air that is fairly cool and fresh, it will certainly improve the efficiency of that employee.

J. H. Miller: I take it then, that you have the same number of relief men you had before you instituted the ventilating?

J. L. Ferguson: In some cases we do and in some we don't. In some instances we find it possible to do away with relief men.

R. R. Steinmetz: I want to know whether the insulating blanket is rigid or of the flexible type as used in the walls and floor.

J. L. Ferguson: It is rigid. However, soft or pliable insulation may be used if packed tightly to prevent settling.

R. R. Steinmetz: Why is the metal jacket used on the inside of the cab?

J. L. Ferguson: The metal jacket is used on the duct line carrying cooled air from the unit to the crane cab.

R. R. Steinmetz: What maximum temperature must your insulation stand, say in the floor of your cab right over the soaking pit?

J. L. Ferguson: It will vary there. If you are over a pit drawing steel, the temperature will probably approximate anywhere from 1800 to 2200 degrees.

R. R. Steinmetz: Why isn't more insulation used in the bottom then?

J. L. Ferguson: In some cases it is protected by a dead air space or a shield. You have that in addition to the regular insulation. In other words, you are protected by a shield from the radiant heat and then you have two inches of insulation.

R. R. Steinmetz: You feel that would be of help in the bottom to take care of that high temperature?

J. L. Ferguson: We think so. While I am here, I would like to reopen a question asked a few minutes ago. Mr. Hjortsberg stated that they were having some difficulty with the crane men leaving the door open and why not interlock the cab door with the unit. In all probability that could be done if you had someone to watch the crane operators. So far, I have never found anyone who can keep a craneman or an operator from blocking relays, contactors, or switches and I am rather confident that any mechanism or apparatus connected to a door so that when the operators open the door they would automatically shut the unit down would be rendered useless by the crane operators.

F. J. Wood: Going back to the insulating glass, I believe there is a definite use for it here. This glass is really two sheets of glass with a dead air space between, all hermetically sealed, so that there may be 10 or 15 degrees difference between the inside and the outside temperatures.

F. E. Kelly: What is your experience as to gas used in the cooling units in crane cabs?

J. L. Ferguson: The gas most commonly used is Freon. Probably some manufacturers will advocate the use of some different refrigerants such as sulphur dioxide and others but I think most of them stick to Freon.

F. E. Kelly: Is there any danger in Freon to the person in the cab?

J. L. Ferguson: As far as I know, there is no danger in the use of Freon gas.

W. A. Lintern: Freon is non toxic, while methyl chloride is toxic. Authorities recommend the use of Freon in conditioning small enclosed spaces because of this property. It is also recognized as the best refrigerant for high temperature work.

Dynamic Braking

CRANE HOIST LIMIT SWITCHES

. . . . many factors affecting limit switch operations are a direct result of design . . . . a well designed installation does much to eliminate maintenance troubles . . . .

by C. G. Dimitt

CARNEGIE-ILLINOIS STEEL CORPORATION

SOUTH CHICAGO, ILLINOIS

▲ CRANE hoist limit switches are installed to guard against the dangers of overhoisting. When a hook block drops, there may be physical injuries or fatalities to workmen, damage to equipment, or both. Despite improvements made in recent years to crane hoist equipment, hook blocks still drop. Experience indicates that there is no cure-all which can be applied to keep crane hoist limit switches functioning properly and prevent overhoisting.

It is the purpose of this discussion to point out some of the factors affecting the operation of dynamic braking limit switches, applied to dynamic lowering hoist controllers. Many factors affecting limit switch operations are a direct result of installation design. It is believed that the maintenance of equipment begins with engineering designs and layouts. A well designed installation does much to eliminate maintenance troubles in the operation of the equipment.

Figure 1 shows a typical limit switch arrangement using cable sheaves. The limit switch itself is essentially a double throw switch, operated by counterweights. The lower counterweight, or hinged trip bar, overbalances the effect of the upper counterweight, mounted in this case directly on the limit switch operating arm. Raising of the trip bar by the hook block permits the upper counterweight to quickly change the switch contacts from the normal operating position to the braking position.

It will be noted that the cable between the limit switch operating arm and the trip bar must pass over three cable sheaves. Cable sheaves introduce friction between cable and sheaves. Friction causes cable wear, and may also cause sluggish operation of the switch. A sluggish limit switch may permit a hook block to overhoist and drop. In general, the use of cable sheaves should be avoided. However, when sheaves must be installed:

1. Use the minimum number possible.
2. Make the diameter at least 6 in. and preferably 8 in.
3. Use anti-friction bearings and provide for easy lubrication.
4. Make cable sufficiently flexible to keep it on the sheaves at all times.
5. Provide cable guards on sheaves when possible.
6. Make the lower counterweight sufficient to reset the limit switch, regardless of friction developed in the sheaves.

In Figure 2, cable sheaves have been eliminated by the use of bell cranks. The advantages of such an arrangement are:

1. It eliminates the friction encountered in sheaves.
2. Cable flexibility is not critical.
3. Straight lengths of cable can be used.
4. Frequently two bell cranks will replace three cable sheaves.

In Figure 3, a direct connection has been provided between the trip bar and the limit switch operating arm. Such an arrangement reduces the number of parts used, reduces wear and replacements, and reduces equipment below the trolley floor where it is usually inaccessible and therefore neglected.

In making the direct connection for this particular installation, the cable from the limit switch operating

Presented before A. I. S. E. Chicago District Section Meeting, April 4, 1944.

arm was connected to the trip bar near the center. This results in the limit switch cable being raised at approximately one-half the rate the trip bar is being raised by the hook block. Under no load, high speed conditions, the block may overhoist and drop, if insufficient head room has been provided.

In Figure 4, a direct connection has been properly made between the limit switch operating arm and the trip bar. It will be noted that the limit switch has been mounted on a platform where it is accessible for inspection and maintenance, and where it is free from accumulations of mill dirt, oil and grease.

In Figure 5, the advantages of the previous arrangement have been retained, and in addition a swivel has been provided to permit movement of the trip bar when the hook block swings or when side lifts are made.

In Figure 6, a direct operating arrangement, having a cylindrical counterweight hanging on the limit switch cable, is shown. Such an installation has a minimum of parts, it eliminates all apparatus under the trolley floor, the cable or counterweight is easily replaced, and a guide is provided around one of the hoist cables.

However, with this arrangement the counterweight may swing due to the movement of the hook block as the block approaches, permitting a higher hoist than is intended. Also, the counterweight may jam between hoist cable and hook block. Furthermore, due to repeated movements of the counterweight, the guide may cause serious wear on the hoist cable resulting in frequent cable replacements and in cable failures, if replacements are not made in time.

To prevent wear on the hoist cables, replaceable wood, bakelite, or rubber hose wearing pieces have been used to good advantage.

Figure 7 shows a piece of billet stock used as a counterweight, with a bar guide around both cables. This arrangement reduces wear on the cables somewhat and helps center the counterweight over the hook block.

Figure 8 shows a similar arrangement, using a piece of billet stock. The counterweight is held in position

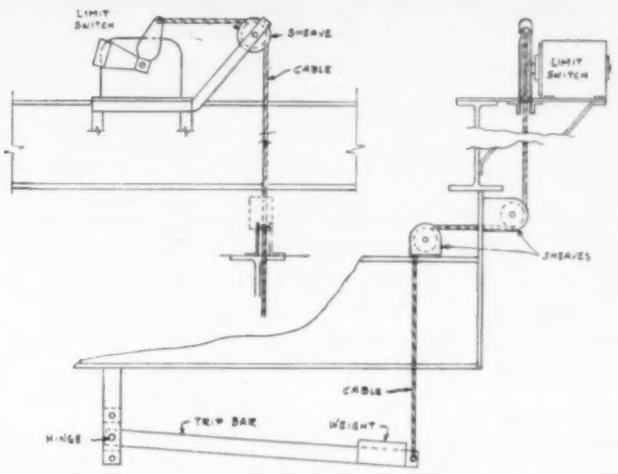


Figure 1 — Typical tripping arrangement using cable sheaves.

▲

Figure 2 — Typical tripping arrangement using bell cranks to replace cable sheaves.

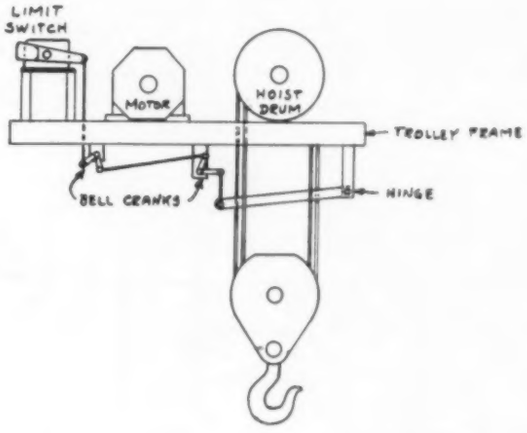


Figure 3 — Direct tripping arrangement with limit switch cable connections near center of tripping bar.

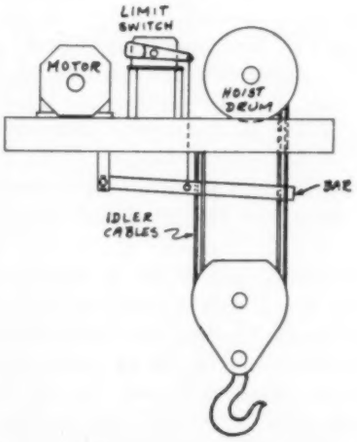


Figure 4 — Arrangement with limit switch cable connections near end of tripping bar.

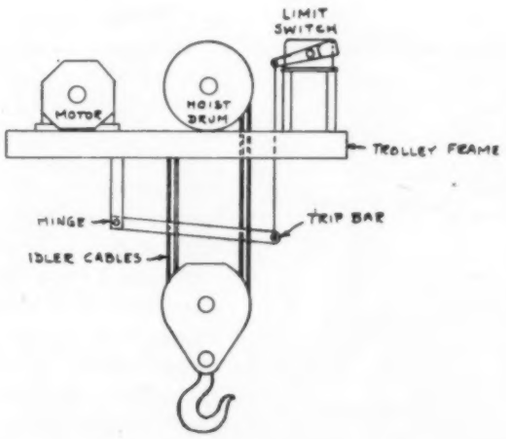
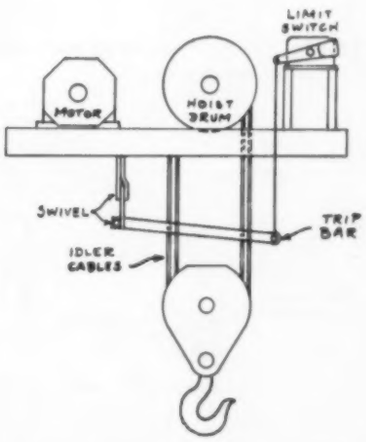


Figure 5 — Arrangement using one form of swivel.



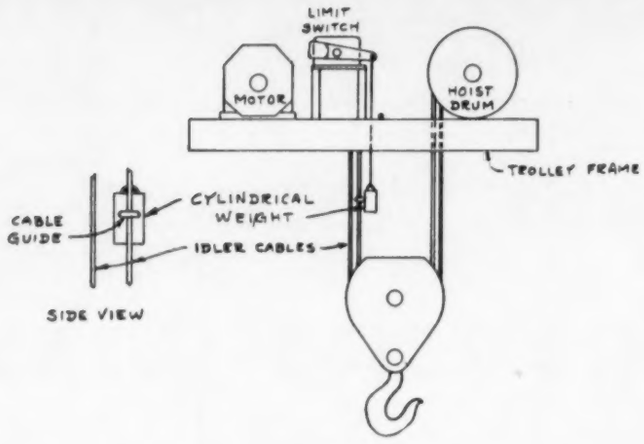


Figure 6 — Arrangement with cylindrical counterweight, one cable guide.

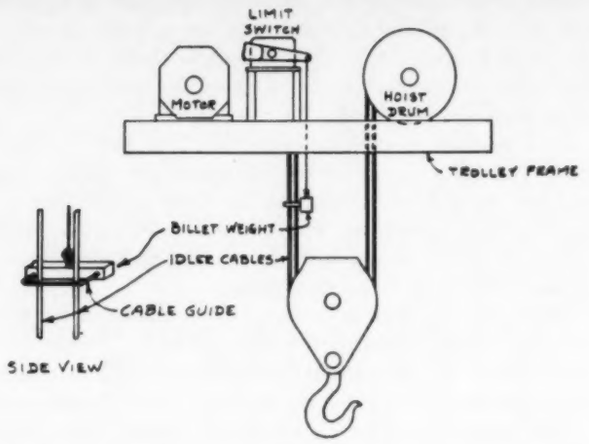


Figure 7 — Arrangement with billet counterweight, two cable guide.

over the hook block, but considerable wear on the hoist cable may be experienced.

Figure 9 shows an arrangement in which a cylindrical counterweight is held in position by two cable guides, provided with replaceable maple or bakelite guide blocks to prevent wear on the hoist cables.

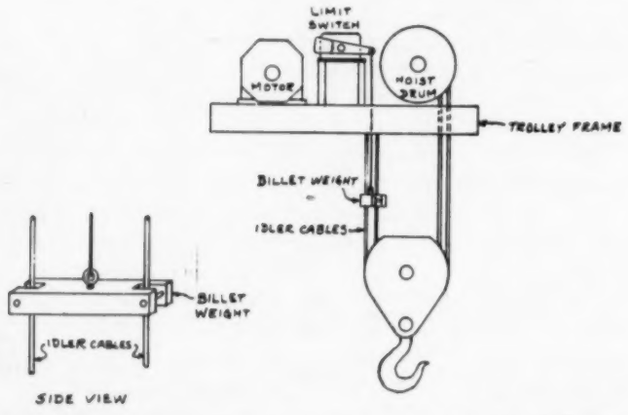


Figure 8 — Another arrangement with billet counterweight, two cable guide.

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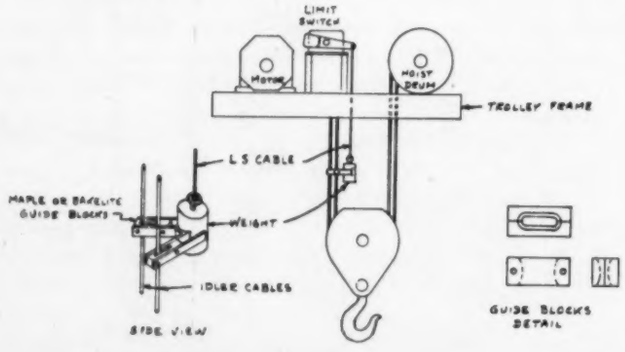
Figure 9 — Arrangement with cylindrical counterweight two cable guide.



In general, most counterweight devices having cable guides are placed on the idler cables. However, there are applications where the counterweight is placed on the live cables to reduce the effects of wear due to the cable guides. When guides are installed on live cables, care must be taken to prevent an uplift by the cable on the counterweight, giving a false operation of the limit switch.

In connection with the wear on hoist cables, there is also a possibility of the limit switch cable wearing or fouling on the structural members of the trolley frame, or the limit switch stand, or in passing through the floor of the trolley. The limit switch cable should be kept clear and free during all operating conditions.

Figure 10 shows a partial plan of an arrangement on a bucket hoist trolley. For bucket, ladle, and other types of cranes requiring two drive motors, two standard, single motor limit switches are usually coupled together to provide simultaneous operation. In the original layout for this crane, as shown, two limit switch cables were connected to a single trip bar. In obtaining this close coupling, the limit switches were crowded together between drum and motor. The left limit switch interfered with the brake and motor lead connections. The resistor locations further complicated the wiring.

In Figure 11, a sectional elevation further emphasizes the crowded, inaccessible position of the limit switches, mounted on the floor, subject to dirt and oil accumulations. The swivel arrangement shown consists of a round bar, having two collars, permitting rotation of the trip bar hinge, which in turn permits side movements of the trip bar when the bucket cables swing against it.

Figure 12 is a sectional elevation of the revised layout. Each limit switch is mounted on a raised platform adjacent to the motor it serves. The resistors have been mounted on a shelf under the limit switches, protecting them from weather and mechanical injury. Access to the resistors is from the far side. Two duplicate trip bar arrangements have been provided, one left hand, one right hand.

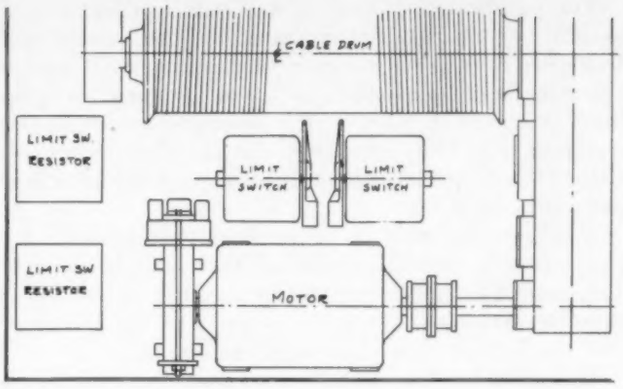


Figure 10 — Original layout for two-motor bucket hoist.

Although all of the limit switches shown schematically so far have had but one hanging counterweight, with a counterweighted operating lever arm for tripping the limit switch, some types of switches utilize two hanging counterweights, as indicated in Figure 13. With such installations, means must be provided to keep the hanging counterweight on its cable from fouling, and preventing operation of the limit switch. Depending upon installation conditions, a cable guide similar to those shown previously, or a sufficiently large pipe guide may be used for the counterweight.

In Figure 14 is shown one method of replacing the sheave and hanging counterweight with a counterweighted operating arm for a limit switch of this type. Note the platform provided on the hook block to engage the trip bar.

The question of whether to use a trip bar or a guided weight for the lower counterweight is an involved one.

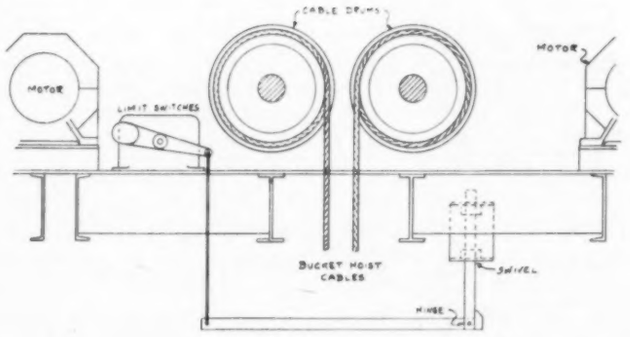
Figure 11 — Sectional elevation of original layout for bucket hoist. (below)

▲

Figure 12 — Sectional elevation of final layout for bucket hoist. (right)

▲

Figure 13 — Typical arrangement showing sheave and hanging counterweight. (bottom right)

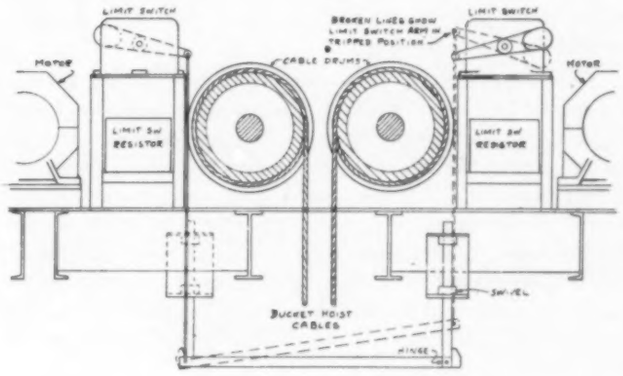


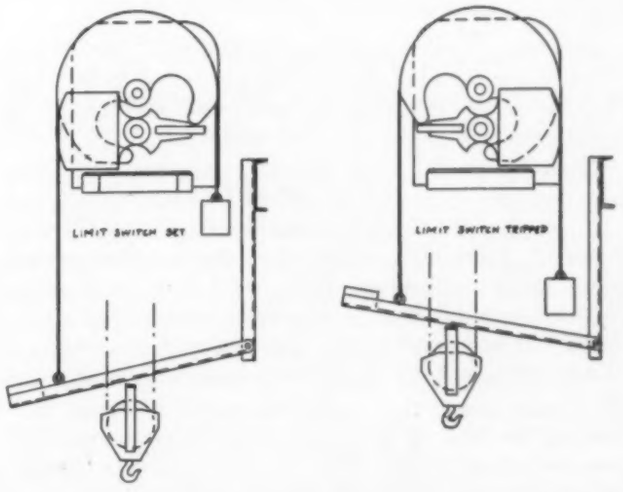
There are many applications where each type may be used to advantage. Frequently the choice is influenced by the experience of those responsible for the installation. Some of the factors affecting a choice are:

1. Handling loads which cause a hook block to swing.
2. Handling side lifts.
3. The frequency and extent of the types of handling required.
4. The mounting facilities available.
5. Accessibility for inspection and maintenance.
6. The head room available above and below the trolley floor.
7. The interferences present, such as when an auxiliary trolley must pass under a main trolley on a ladle crane.

When a bar arrangement is used, keep the cables from jumping out around the end of the trip bar, permitting the hook block to raise outside of the trip bar. Also, be sure that movements of hoist and trolley will not permit the bar to jam against any part of the crane structure. In either case, limit switch operation is prevented, and blocks will drop.

When a hanging counterweight is used, keep the weight above the hook block at all times by using suitable cable guides. Also, provide means to prevent wear on hoist cables due to movement of the guides. With either type of installation, the standard limit switch





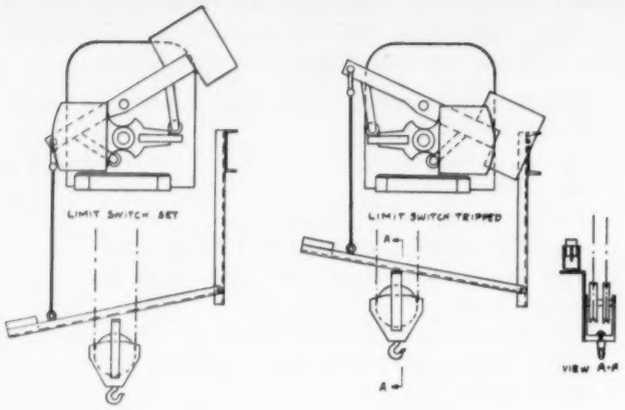


Figure 14 — Typical arrangement showing elimination of sheave and hanging counterweight.

enclosing cases may be insufficient protection for outdoor cranes exposed to the weather or for metal handling cranes at hot metal mixers or converters. In such cases, a separate enclosing case of comparatively heavy gauge plate may well be installed, completely housing the limit switches and the resistors.

The resistors for all types of installations should be of nonbreakable, corrosion resisting construction.

Assuming the best installation has been made under the conditions existing, there is no substitute for good inspection and maintenance to insure the reliable operation of a limit switch.

The frequency of inspection may well be at weekly intervals for hard worked cranes over peopled areas such as billet docks, shops, shipping docks, etc.; at twice a month intervals for heavy duty mill cranes, metal handling cranes, mold and slag yard cranes, stock yard cranes, etc.; and at monthly intervals for motor room, power station, and similar types of cranes. Such inspections and reports of inspections should be made by electrical maintenance men, supplementing the crane condition reports made by crane operators at the end of each turn.

When electrical inspections are made, how should the inspector report his findings?

Figure 15 shows one form of inspection report which itemizes the essential parts of a limit switch installation in detail. This type form is of particular value in training new men in what to look for, and where to look for it.

Notice that one item covers a tripping test. This tripping test may well consist of two operations:

First, gradually inch into the limit switch, observing if the hoist stops operating when the counterweight is raised by the hook block. If the hoist does not stop, the crane should be shut down until repairs have been made. If the hoist does stop, proceed with the test.

Second, lower the hook block eight to ten feet and then raise it at the maximum speed attained, permitting the limit switch to stop the hoist. Successfully passing such a test should be an indication of the operating condition of the limit switch.

Of course, such tests should be conducted over areas where the failure of the limit switch under test conditions will not cause hazards to workmen.

The significance of some of the electrical features of a limit switch installation may well be considered. In Figure 16 is shown a schematic diagram of a dynamic lowering hoist controller having a dynamic braking limit switch. The limit switch elements consist of the contacts LS1, LS2, LS3, LS4, and the limit switch resistor. These contacts are grouped around the armature and series fields.

In Figure 17, with the same circuit setup, assuming contactors H and M are closed, limit switch contacts LS1 and LS4 complete the series motor connections for hoisting. Arrows indicate the rotation of the armature and the flow of current through the circuit.

In Figure 18, the circuit shows conditions just after the limit switch has been tripped. LS1 opens the tie between the armature and the series fields. LS4 opens the circuit from the positive line. LS2 and LS3 close the circuit between the armature, series fields, and the limit switch resistor. As long as rotation continues, current flows as indicated by the arrows, giving a dynamic braking action.

Notice that the series brakes are not included in the dynamic braking circuit. When LS4 opens, the series brakes should set immediately. The stopping of the hoist is due to the combined braking action of the series brakes and of the motor. For those installations where the tripping bar or counterweight has been located to give the maximum possible hoist, based on the actual distance required to stop the block under normal braking conditions, the failure of either form of braking when hoisting under no load, high speed conditions, may cause a block to drop. Therefore, it is important to

Figure 15 — Limit switch inspection form.

MOTOR INSPECTORS REPORT OF
CRANE HOIST LIMIT SWITCH INSPECTION

DEPT _____ TIME _____ M _____ 194__
CRANE _____ HOIST _____ TYPE OF SWITCH _____

APPARATUS INSPECTED	CONDITION FOUND	REPAIRS MADE
CONTACTS & SUPPORTS		
ARC SHIELDS & BLOWOUT COILS		
SHUNTS - BUS CONNECTIONS		
INSULATORS		
WIRING LUG CONNECTIONS		
SPRINGS		
COTTER PINS		
BEARINGS - BEARING BOLTS		
LUBRICATION OF BEARINGS		
CABLES - CLAMPS - SHEAVES		
COVER - COVER CLAMPS		
SWITCH & RES MOUNTING BOLTS		
RESISTOR GRIDS & CONNECTIONS		
CLEANLINESS - SWITCH & RES		
MOTOR BRUSHES - SHUNTS		
MOTOR BRUSHHOLDERS		
MOTOR COMMUTATOR		
MOTOR CONNECTIONS		
RESULT OF TRIPPING TEST		

REMARKS.. GIVE A BRIEF DESCRIPTION OF ANY WORK DONE WHICH IS NOT COVERED BY THE ABOVE USE REVERSE SIDE IF NECESSARY

IS LIMIT SWITCH NOW IN SAFE OPERATING CONDITION?

NOTED _____ MAINT FOREMAN INSPECTED BY _____

NOTED _____ CRANE INSPECTOR

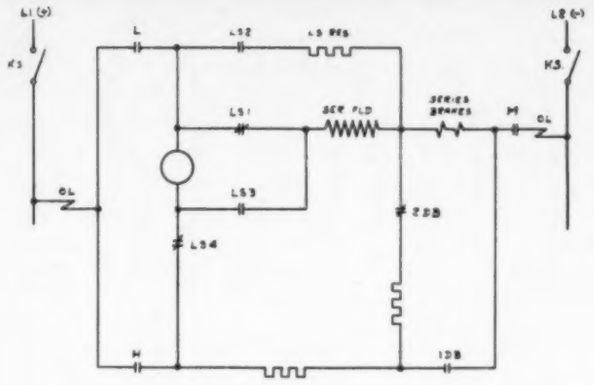


Figure 16 — Typical dynamic lowering controller circuit with dynamic braking limit switch.

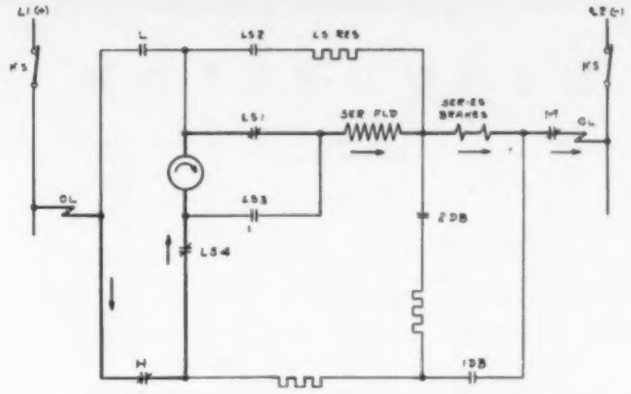
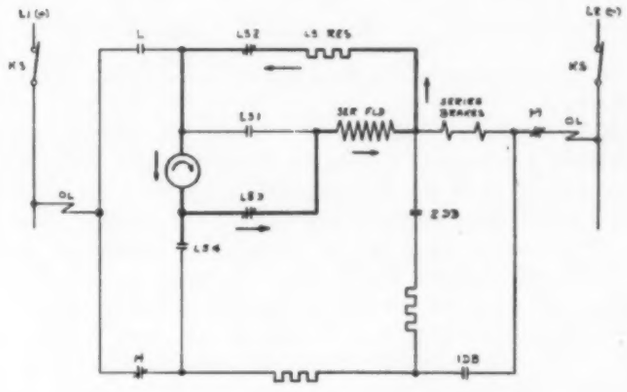


Figure 17 — Hoist connections in dynamic lowering circuit.

Figure 18 — Limit switch braking connections in dynamic lowering circuit.



keep the series brakes adjusted to the proper torque value at all times.

This electrical circuit setup for dynamic braking indicates a series generator action with a load consisting of the limit switch resistor. Under most operating conditions, the limit switch is tripped while power is flowing through the motor circuit. The field flux does not have time to decay, and the build-up of voltage is immediate. However, if the power is removed just before the limit switch is tripped, the field flux does decay and voltage must be built up from the residual flux.

One of the characteristics of a series generator is that if a certain critical resistance is exceeded, voltage will not build up from residual flux. The critical resistance can be exceeded due to:

1. Loose lug or terminal connections.
2. Loose or broken resistor grids.
3. Poor condition electrically of brushes, or brush shunts, or commutator.
4. Poor condition electrically of limit switch contacts.

In such case, the hoist must be stopped entirely by the series brakes. If the series brake torque is insufficient to stop the hoist in time without the aid of motor torque, the hook block will drop.

This circuit analysis emphasizes that a crane hoist limit switch is a device to set up circuits for normal operations of hoisting and lowering, and for braking operation when hook block travel exceeds a desired limit. The actual stopping of the hoist is due to the braking action of the series brakes and the motor.

The motor torque when braking is determined by the current flow. The current flow is determined by the value of resistor used, and the speed of the hoist motor. No load speeds may reach 235 per cent or more. With such speeds a limit switch resistor which has been selected to give 150 per cent current at 100 per cent speed, will permit a dynamic braking current peak which may exceed 300 per cent. This value of current may not be handled by some types of motors without severe arcing at the brushes. If operations are frequent with such current peaks, high motor maintenance can be expected. In many cases it is advisable to increase the resistance value to decrease the current, providing the hook block can be stopped safely under all operating conditions, in the space available.

In conclusion, the observation is made that while most of the foregoing discussion has been confined to installation and maintenance features, the operating practices of the crane operators in a plant must not be overlooked.

One of the operating practices which contributes greatly to jeopardizing the condition of a limit switch installation is that of using the limit switch as a service stop, when it is intended as an emergency safety device. Service stopping requires many more operations a turn than should be expected of a limit switch during long intervals of normal operation as a safety device. If current peaks of 250 to 285 per cent are handled for frequent service stopping, high electrical and mechanical maintenance can be expected, and the limit switch installation as a whole may deteriorate, and fail as a safety device, in spite of frequent inspections and servicing.

This indicates one of the possibilities of closer cooperation between operating and maintenance men in keeping limit switches properly maintained and hook blocks on the cranes where they belong.

DISCUSSION

PRESENTED BY

A. R. DIBBEN, Assistant Electrical Superintendent, Youngstown Sheet and Tube Company, East Chicago, Indiana

C. G. DIMITT, Engineer, Carnegie-Illinois Steel Corporation, South Chicago, Illinois

K. A. DAUGHERTY, Electrical Engineer, Tubular Alloy Steel Corporation, Gary, Indiana

J. H. MILLER, Electrical Engineer, International Harvester Company, Wisconsin Steel Works, South Chicago, Illinois

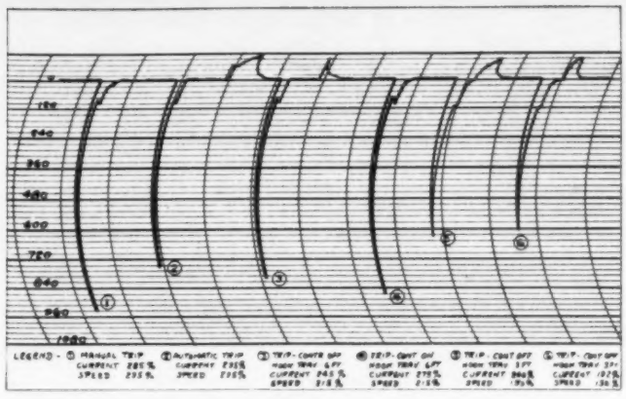


Figure 19 — Graphic meter chart showing dynamic braking current in limit switch resistor circuit, with no load on hook.

A. R. Dibben: Who does the maintenance on limit switches?

C. G. Dimitt: The periodic inspections mentioned previously are made by the local maintenance men in the various mill operating units. Necessary running repairs are made at that time and on any trouble calls by those same men. In the event any inspection or trouble call shows a limit switch to be in serious disorder, it is replaced by a spare limit switch. The defective limit switch is completely rebuilt and it then becomes a spare. In such cases, the repairs are made at the central shop by shop men and not in the field by field men.

We might add also that the periodic inspections made by the local maintenance men are supplemented by inspections made at intervals of three to four times a year by crane or general maintenance inspectors. These inspections are made as a check on the performance of the local maintenance men's inspection and repair work, and no repair work is done by the inspectors.

K. A. Daugherty: We have experienced difficulties in limit stop installations: suitable location for limit stop, use of corner pulleys, all kinds of weights for the tripping lever, etc.

It is difficult to obtain extra flexible cable at the present time. It is essential to use extra flexible cable where corner pulleys are in use as the cable is liable to get off the pulley unless well guarded.

In our plant the majority of the cranes are four-hook, two cables per hook and all are live cables; also the hooks swing out of the vertical in all directions. This paper on limit stops has brought solutions for some of the problems we have encountered.

One control manufacturer has come out with a hoist dynamic lowering circuit whereby the field is reversed instead of the armature. Will this in any way affect the circuit of the hoist limit stop? Another important point that Mr. Dimitt brought out was the diameter of the corner pulleys. He stated the diameter should be six or eight inches and I agree with him. Do not use corner pulleys except in cases where it is impossible to install the limit stop directly over the hook block. The question of safety as well as operation depends on good installation and proper maintenance. Our present day crane

Figure 20 — Dynamic lowering circuit showing backing out connections.

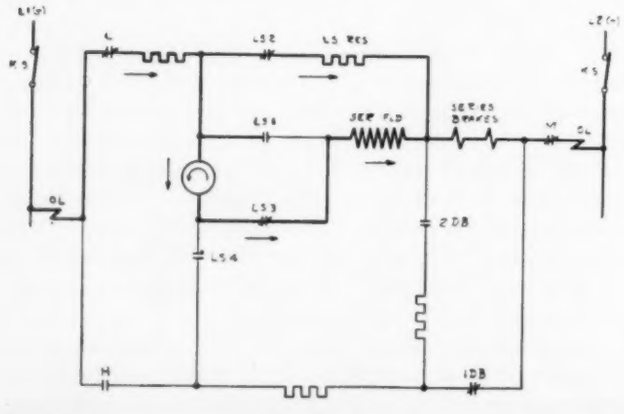
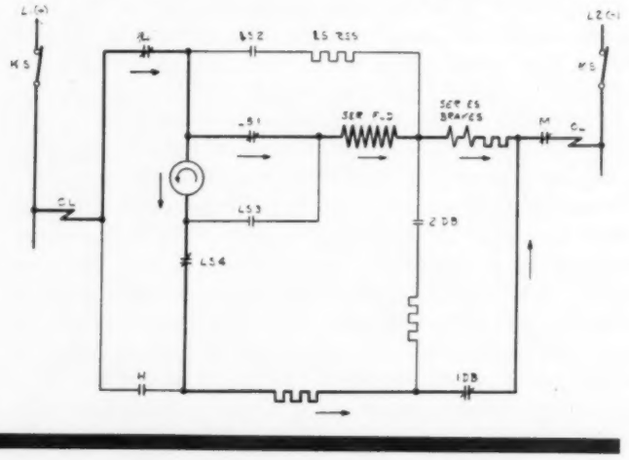


Figure 21 — Dynamic lowering circuit showing limit switch reset and normal lowering connections.



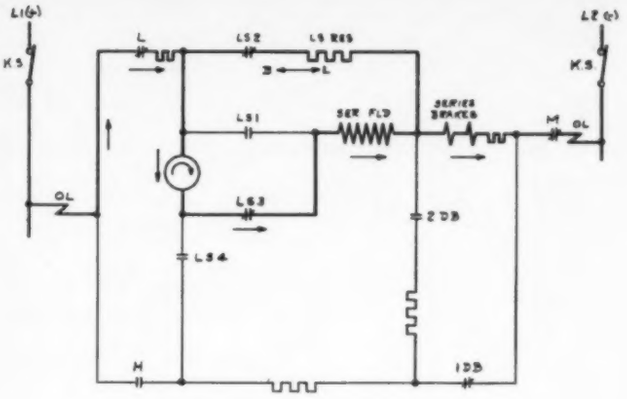


Figure 22 — Circuit conditions showing limit switch tripped just after controller has been plugged from hoist to lower, with hook block still moving in hoist direction.

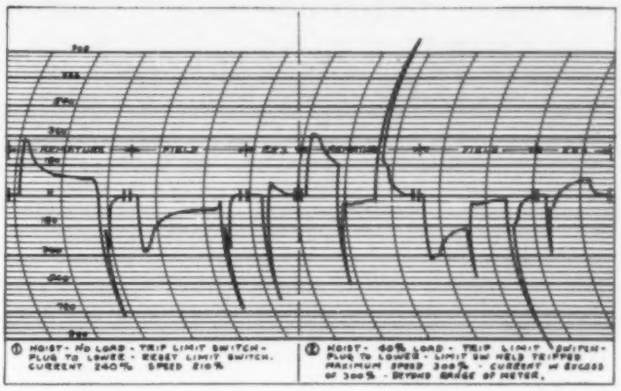


Figure 23 — Graphic meter chart showing current in armature, field and limit switch resistor circuits.

operators, as a rule, do not have the experience of the operators of peace time days and the limit stops are used much more as a service stop instead of an emergency stop.

One more question; if the hoist controller was reversed just as the limit switch was tripping, would the load run away? To the best of my knowledge, this has never occurred at our plant but I am informed it has happened in other plants.

J. H. Miller: I would like to say at this time in support of Mr. Daugherty that the diameter of the sheave wheel is important. We have standardized on 8 in. minimum and we would like to keep them at least that much. He also brought out the point that limit stops are a matter of safety as well as operation. There is another point I would like to make since there are a few crane manufacturers' representatives here tonight and that is, the mounting of limit switches by the manufacturer, (they usually put them under a jack shaft or something like that where you can't get at them and it is a matter of relocating so they may be maintained.) Cables and the number of pulleys are also a problem for us to figure out — such as a safer way of running the cables and getting rid of about half the pulleys.

C. G. Dimitt: Mr. Daugherty has raised some very interesting questions. From time to time we receive reports involving limit switch failures, resulting in a block dropping, a load running away, etc. Usually there is an investigation of the failure, but in most cases it is difficult to definitely determine the cause of the failure. Recently we analyzed some of the conditions which we believed might cause abnormal limit switch operation, and some load charts were made.

Figure 19 shows graphic meter records of some limit switch operations on a 20-ton slab yard crane with no load on the hook.

1. With the motor operating at 235 per cent speed, the limit switch was tripped manually, giving a current peak of 285 per cent.
2. While the motor was operating at the same speed as in (1), the limit switch was tripped automatically by the hook block. The lower current peak of 235 per cent is attributed to the time delay encountered in the limit switch operation.
3. With the motor operating at 215 per cent speed, the master switch was moved to the off position just before the limit switch was tripped manually. The current peak was 245 per cent.

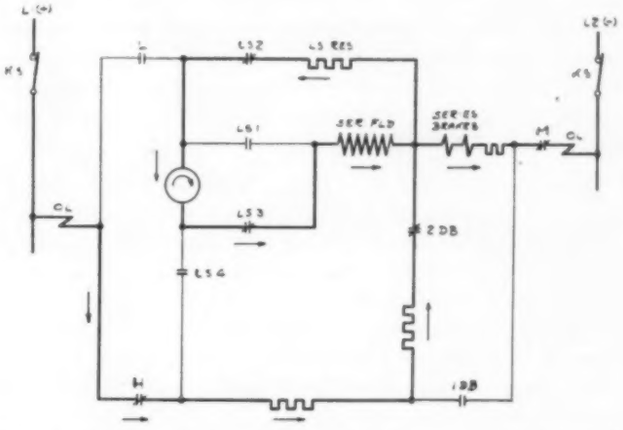
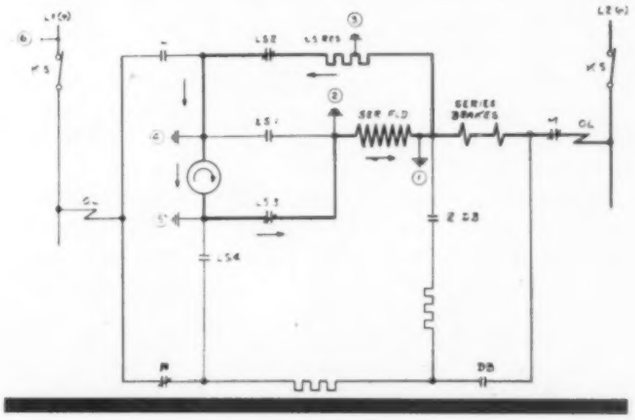
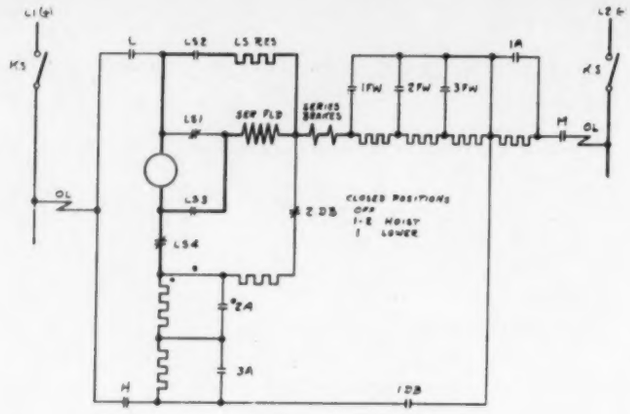


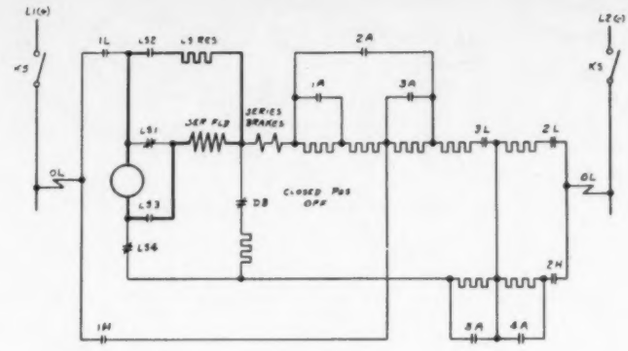
Figure 24 — Circuit conditions with limit switch tripped when motor shunt connections have been made.

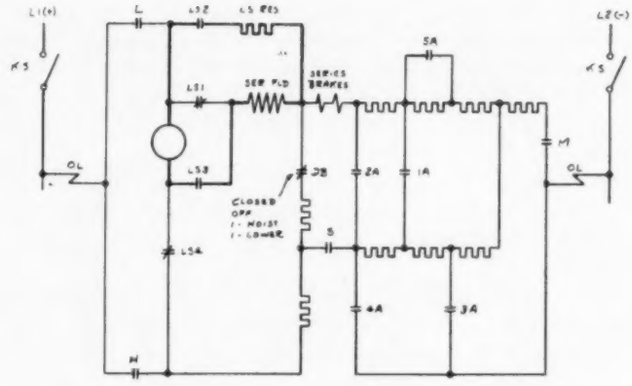
▲

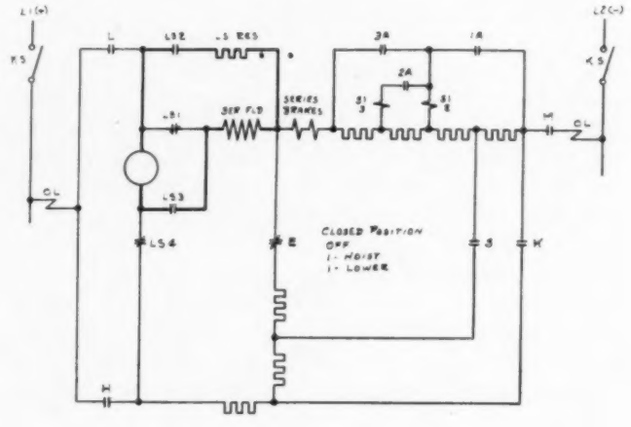
Figure 25 — Circuit conditions with limit switch tripped after motor circuit ground faults have occurred.

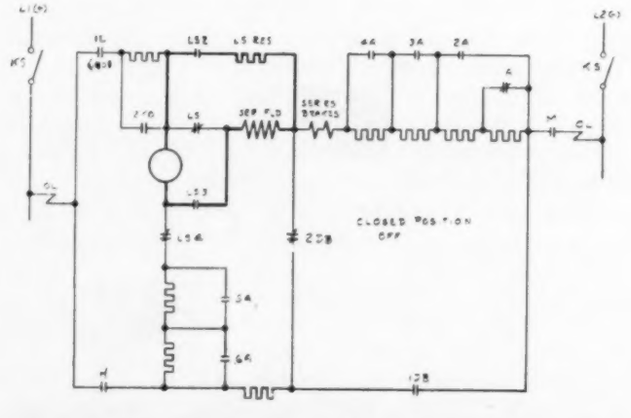












Figures 26, 27, 28, 29 and 30 — Typical dynamic lowering hoist controller as used, respectively, by General Electric, Westinghouse, Clark Controller, Electric Controller and Cutler-Hammer.

4. While the motor was operating at the same speed as in (3), the limit switch was tripped manually with the master switch in the hoist position. The current peak was 275 per cent as compared with 245 per cent in (3). It will be noted that starting from rest, the motor attained a speed of 215 per cent in (3) and (4) in a travel of six feet.

5. & 6. With the motor operating at 150 per cent speed, the master switch was moved to the off position just before the limit switch was tripped manually. A current peak of 200 per cent resulted. This test was repeated to check the results obtained.

Starting from rest, the motor attained a speed of 150 per cent in a travel of but three feet. These tests emphasize that speeds attained in a comparatively short lift are sufficient to cause blocks to drop if the limit switch fails to function properly.

Several backing out operations have been shown following the braking current peaks in (2), (3), (5), and (6). The comparatively low value of current in the motor circuit is of interest.

In Figure 20, the circuit shows conditions during backing out operations. It will be noted that the limit switch resistor is shunted across the armature and fields in series. With this series motor connection, if the limit switch does not reset properly, a dangerous lowering speed with load may be obtained. A similar condition arises if a failure of the limit switch resistor has remained undetected.

During normal backing out operations, the current divides in the parallel circuit as indicated by the arrows.

In Figure 21, the limit switch has reset, and normal lowering circuit connections have been resumed.

Figure 22 indicates circuit conditions when the controller is plugged to the lower position just before the limit switch is tripped. As long as the armature is rotating in the hoist direction, a braking current circulates in the motor circuit in addition to the current from the line. During this period, the current through the limit switch resistor is in the direction indicated by the arrow head B. After the motor comes to rest, current from

the line flows through the limit switch resistor in the direction indicated by the arrow head L.

In the first half of Figure 23, armature, field, and resistor current peaks show the conditions outlined in Figure 22.

In the second half of Figure 23, a test was recorded to show the results of a limit switch failing to reset properly. While hoisting a 40 per cent load on the same 20-ton hoist, the controller was plugged to the lower position just before the limit switch was tripped manually and held tripped. The chart shows that after the braking current subsides, the backing out current in the series motor circuit, which is in the same direction as the (5) lowering current, quickly reaches a very low value, giving a motor speed of approximately 300 per cent. At that time, the operator became alarmed at the speed the hoist was attaining, and returned the master switch to the off position. The ensuing dynamic braking current peak when the normally closed DB contactor closed, was in excess of 300 per cent, beyond the range of the meter.

Referring now to Mr. Daugherty's question regarding a run away in the event the controller was reversed just as the limit switch was tripping, Figures 22 and 23 would seem to indicate that if the limit switch functions normally, there will be no run away. However, if the limit switch does not reset properly, a load on the hook will cause a run away. These charts emphasize that it is important that the limit switch reset properly, as well as trip properly.

Some types of controllers use a motor shunt connection on the first or second points in the hoist direction. Figure 24 shows conditions when an operator returns the master switch to a motor shunt point just before the limit switch trips. It will be noted that a circuit is maintained through the series brakes so that braking action is obtained from the motor only. This creates a condition which may cause a block to drop when hoisting without a load and consequent high speed. Also, if the master switch is not moved to the off position when the block comes to rest, a load hanging on the hook will cause the block to lower, resetting the limit switch, and so re-establish hoist connections again, creating a hunting action until the master switch is centered.

Figure 25 presents some interesting possibilities if ground faults should occur at points 1, 2, 3, 4, or 5. Assuming a return to the positive bus through a plant ground fault, a ground fault at one of the points indicated will tend to keep the brakes energized after the limit switch has tripped, with results as previously outlined. A ground fault at point 5 may conceivably result in current flowing through the armature and fields as a shunt motor connection, and in a direction to prolong the overhoisting action, and cause a block to drop.

The importance of keeping a limit switch installation free of grounds can not be stressed too much.

In Figures 26, 27, 28, 29 and 30, the limit switch dynamic braking circuit has been shown in its setting in typical dynamic lowering crane hoist controllers as furnished by the five manufacturers of this type of equipment. It will be noted that these circuits have been made to conform to the typical circuit used previously in this discussion. The standardization and use of the elementary circuit in a common design on wiring diagrams by all of the manufacturers mentioned would greatly facilitate the maintenance and repair of limit switch installations in the field.

Mr. Daugherty has asked a question about the controller reversing the field instead of the armature as in conventional controllers. The writer has had no personal experience with this controller. However, we believe a study of the circuit shown in figure 24 will show that the limit switch can be applied in the same manner as to the conventional controller reversing the armature, by making the proper connections, and will require no additional devices or equipment to obtain the same results.

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. . . . grooving of commutators and collector rings properly done, has been found to improve commutation and eliminate burning . . . .

by W. B. Ferguson

ELECTRICAL ENGINEER

CARNEGIE-ILLINOIS STEEL CORPORATION

SOUTH CHICAGO, ILLINOIS

▲ THE spiral grooving of commutators and collector rings dates back, I believe to about 1930. At least, the first indication I had of such applications was in 1931 when an article was published covering helical grooving of slip rings and commutators. Figures 1 and 2 are some actual photographs of rings and a commutator grooved in 1931. The reaction to these might easily be: "What in the world were you trying to do?" Frankly we didn't know too well then. These photographs are merely to acquaint those who may not be entirely familiar with helical grooving. They are very good examples of how not to groove a commutator or collector rings. They were both early experiments. The rings, I believe, were on a 400 hp synchronous motor and the commutator was a 60 hp motor. The two sets of grooves were a double spiral, ⅛ in. groove and ⅛ in. deep, which left a land ⅛ in. wide. But, as ridiculous as they look and in spite of their having cut away one-half to one-third of the active surface, the commutation was improved.

We graduated from this particular groove to some which will be shown a little later, but first I think it might be well to go back to 1931 and get some of the facts which led us to grooving.

Contrary to our thoughts, a brush does not carry current on all parts of its surface. In other words, we naturally assume a brush to be a series or multiplicity of contacts which come in contact with the surface being commutated or collected. This is not the truth however. Actually, under normal pressures, there are only 5-7 points of contact under an average sized brush. That may seem startling, but it is nevertheless a fact and has been proven by oscillographs and, in some cases, photographs. Under very high pressures this number of contact points may raise from 5-7, to perhaps 50-100. That is, of course, on an ungrooved surface.

There will attend this high brush pressure, increased temperatures, much more rapid surface and brush wear. There have been a number of attempts made to improve commutation by the use of split brushes, in some cases using a coarse brush in one section and a smooth or denser brush of greater conductivity in the other half of the brush holders. This has its good effects.

Although grooving is not a cure-all, if there is no inherent property in the machine which unbalances it electrically, or some other feature which causes poor commutation, I believe grooving will help. My experience with several hundred motors which have been grooved has been very phenomenal.

I would like to point out one or two specific cases. I recall in particular machine tools which had the 3 hp drive motors built into the lathe leg and thereby restricted as to size. Through a change in the nature of the work, the load on these drives was increased to around 5½ hp and at times considerably higher peaks, which made commutation rather a serious problem and necessitated the replacement of commutators, and in some cases, armatures, at frequent intervals. We grooved these commutators and thereafter had no

Presented before A. I. S. E. Chicago District Section Meeting, April 4, 1944

further trouble. They carried the increased load very nicely.

Some time ago at one of the mills in the Pittsburgh district, we grooved the commutator of a hoist motor on a stock yard crane. This particular motor had given a lot of trouble and required replacement of the armature approximately every five weeks. Since the grooving it has been running thirteen months that I know of, without replacement of the armature. These are specific typical examples of what can be accomplished with grooving.

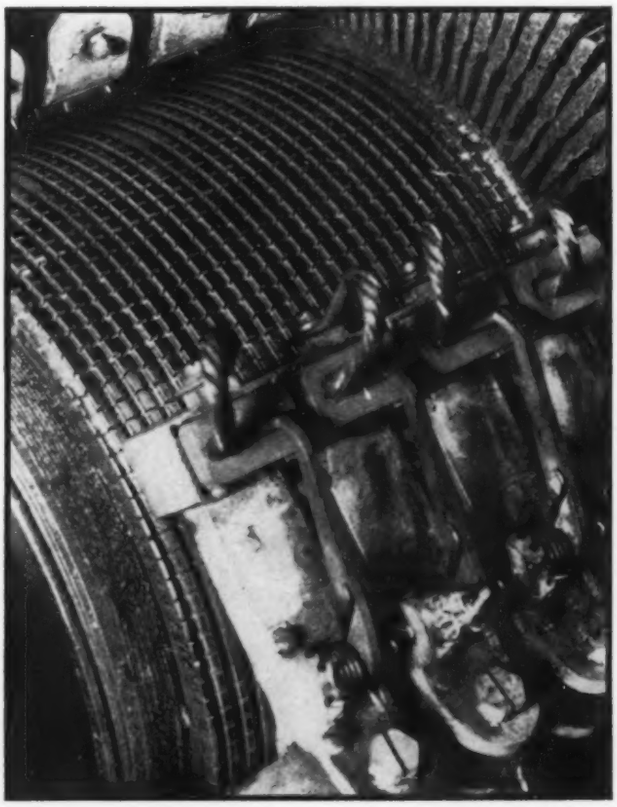
To come back to some of the fundamentals of what grooving actually accomplishes, there are several actions which are quite apparent. First of all, the groove in running under the surface of the brush does two things: It continually wipes the face of the brush which automatically eliminates any particles, or a tendency for particles to be built up and become conducting areas such as occurs on the non-grooved ring or commutator. The wiping of the face of the brush accounts, no doubt, for the fact that the surface of contact or contact points, if we may so state it, increases from 5-7 to somewhere in the neighborhood of 70-100. The fact that the slot or groove is running under the brush continually carrying cool air under the face of the brush results in a cooling action, maintaining the temperature at a lower and a more uniform level. We all know what happens when a brush starts to collect current at one spot. It becomes red and in some cases even melts. This, of course, is brought about by the fact that the temperature coefficient of carbon is negative, and the temperature, as it rises, causes the resistance to drop. This cannot exist on a grooved ring as the surface is continually wiped and shifted so there is no tendency to commutate in spots. This has been proven very definitely.

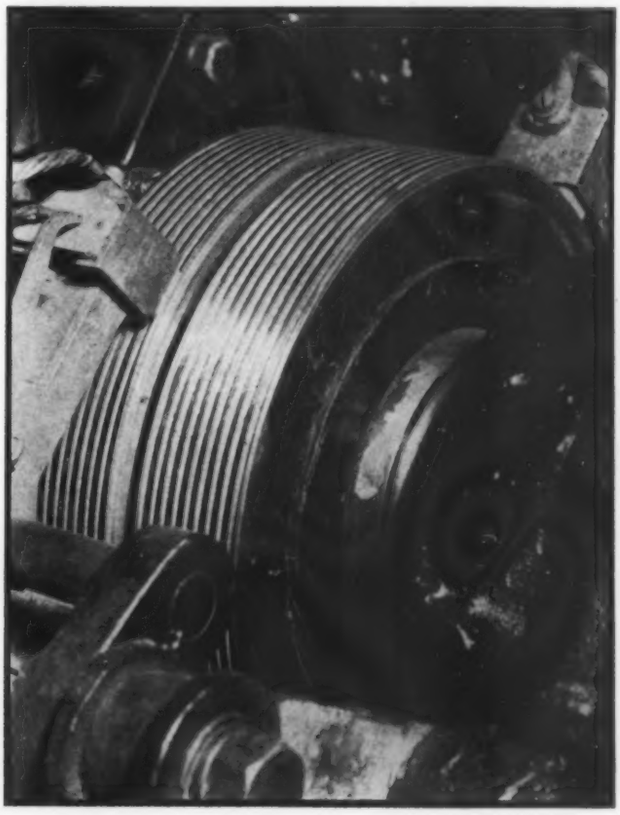
Also, the surface of the commutator or ring is increased in area (depending on the size and the number of slots); this increased area of the surface plus the cooling effect of windage through the slots has actually been found to reduce temperatures as much as 10 degrees C, which in most cases benefits commutation.

I have made some experiments with the removal of brushes. In some cases 50 per cent of the brushes in a group may be removed on any given machine and commutation maintained at a perfect level with no sparking evident. Brush tensions may be reduced to a minimum with grooved rings or commutators, and this also reduces the wear. After brushes have been run for some time on a grooved ring or surface, the surface of the commutator and the brush face both become very highly glazed. In fact, they are just like a polished surface.

There is another thing that might be pointed out here. Every one who has operated is familiar with the flats which burn on ungrooved rings. These have been proven to come from a flash which starts with the initial energizing of the motor or whatever it might be, when the very poor area of contact underneath a brush on a surface which is not grooved raises the current density so high that it actually arcs or sparks to the few points of contact, thereby roughing the area so that repeated rotation thereafter continues to lift out particles of the brush or surface metal in the case of a negative ring. This of course may be overcome somewhat by reversing

Figures 1 and 2 — Early examples of grooving of a commutator and collector rings.





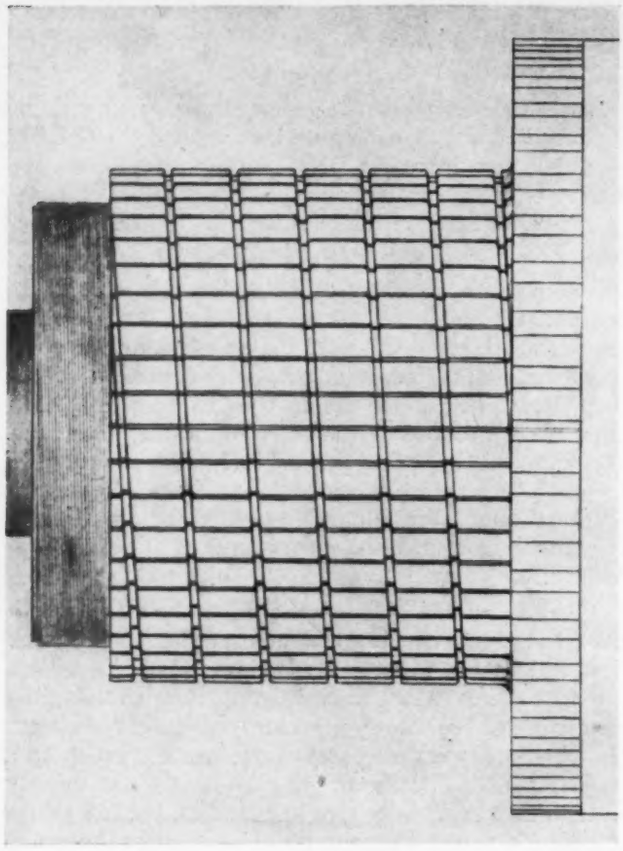
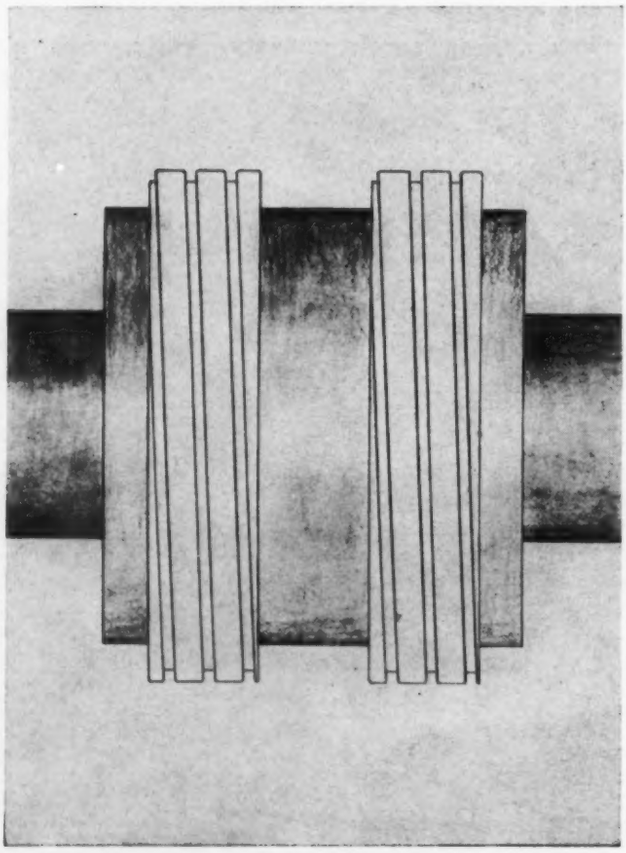


Figure 3 — Sketch of commutator grooved according to modern practice.

Figure 4 — Sketch of a properly grooved collector ring.



the polarity of the field on generators or motors, thereby reducing the tendency to pit the metal on the negative ring. However, with grooved rings burning does not occur; at least that has been my experience.

I want to repeat again that improved commutation may be accomplished by proper selection of brushes. We all know that. There will also be improved commutation due to the use of staggered types of brushes. I am not attempting in any sense of the word to minimize these conditions. However, I believe that it is well worthwhile for those who have motors which are overloaded, or which are running hot and cannot be replaced, to give some consideration to grooving.

Figure 3 is a sketch of a commutator as we would groove it today. I have found that a ring or commutator may be grooved to best advantage by using a 3/32 in. width and 3/32 in. deep slot. It is not necessary to go to a wider or deeper slot. Depending on the size of the surface the pitch may be varied to suit; this will probably be 3/8 in to 1 in.

Figure 4 shows a sketch of a properly grooved collector ring. In other words, the lands should appear or should actually be four to five times the width of the groove. This accomplishes the same results as the fine groove shown in Figures 1 and 2, and leaves a much greater surface for wear.

DISCUSSION

PRESENTED BY

S. S. CALLNER, District Representative, Ideal Commutator Dresser Company, Chicago, Illinois

W. B. FERGUSON, Electrical Engineer, Carnegie-Illinois Steel Corporation, South Chicago, Illinois

A. B. GLOVER, Assistant Electrical Superintendent, Acme Steel Company, Chicago, Illinois

WALTER AHLSTROM, Assistant Superintendent, Station Electrical Division, Commonwealth Edison Company, Chicago, Illinois

S. S. Callner: I gathered from Mr. Ferguson that he has had quite a bit of success from the grooving of commutators. I am wondering by that token if he would encourage the grooving of commutators?

W. B. Ferguson: I would like to modify my answer somewhat by saying that I believe all collector rings either old or new should be grooved. Then, to more specifically answer Mr. Callner, I would say that in many cases where existing machines are over loaded or there is poor commutation, I would most certainly recommend that the commutator be grooved. The size of the groove I mentioned was 3/32 in. x 3/32 in., with the pitch varied to suit the commutator.

A. B. Glover: I would like to ask a question regarding the spiral grooving of commutators. Does Mr. Ferguson recommend any particular type or direction of grooving in regards to the rotation of the ring or

commutator, so that the groove will move across the face of the brush toward or from the windings of the machine?

W. B. Ferguson: I don't believe that makes any difference. On the motor I referred to on the stock yard hoist, I gave the repair department foreman the recommendation on the groove and he put it on backwards and it worked just as well as it did forewards.

Walter Ahlstrom: Our experience with helical grooving of collector rings dates back to the latter part of 1930 and has been with larger units than those discussed here.

Most of our grooving operations have been confined to synchronous converters from 5100 kw to 1200 kw with ring diameters ranging from 2½ to 5 feet. With machines of this size it is not practical or feasible to remove armature and set up in a lathe and the grooving operation is done with the armature in place in its own bearings.

This necessitates rotating the armature by external means, providing a slide rest for your grooving tool on the machine with its travel or lead screw definitely synchronized and tied-in with the rotation of shaft of unit being grooved; in other words building a lathe around the machine.

We have standardized on a 3/32 in. groove, 3/32 in. deep with a ½ in. pitch.

The benefits obtained by grooving in my opinion result mainly from the lower brush tension permitted with helical grooved rings.

Lubricating YOUR *Wire Rope*

▲ THE benefit derived from systematic lubrication of wire rope is one of those apparently intangible things that are difficult for the average user to find among his many operating problems. However, laboratory and scientifically controlled field tests have proved that wire rope, like any machine part, lasts longer if it is kept well lubricated.

What are some simple ways to lubricate wire rope on your job? It is very desirable that the rope be clean and dry. A jet of air, steam, or wire brushing, followed by a period in which the rope is allowed to dry, are some of the methods used preparatory to applying the lubricant.

First, you can brush the lubricant on to the rope. This is one easy and effective method of applying lubrication. Dip the brush into the lubricant and apply. In some cases a rag or piece of sheepskin is dipped in the lubricant and used to swab the lubricant on to the rope.

Another simple method is applying by hand with leather gloves. Leather is preferred to canvas, because of its greater protection and less penetration of the grease. This method is especially good where a heavy, non-flowing lubricant is applied. It is often desirable to heat lubricant slightly to get a smoother, better application.

A wooden trough with a sheave mounted on a shaft does a good job. Such a trough, or slush box, is illustrated in Figure 1. The rope is run over the end of the trough, under the sheave, and out the other end so that the rope runs through the lubricant. A rag or swab held in place at the outgoing end wipes off excess lubricant. A slush box for vertical ropes is shown in Figure 2.

Regular inspection of the rope with frequent applications of lubricant produces better results than heavy coatings less frequently applied. The methods illustrated are those in most common use and cover most wire rope applications.

(From the Macwhyte Company)

↓ Figure 1

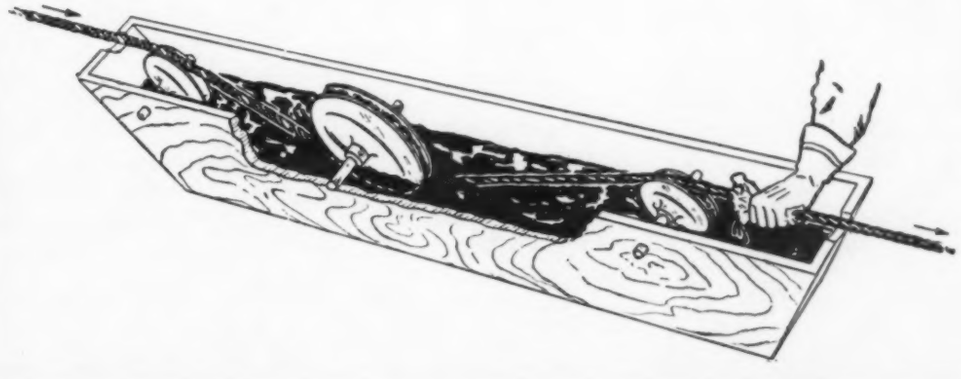
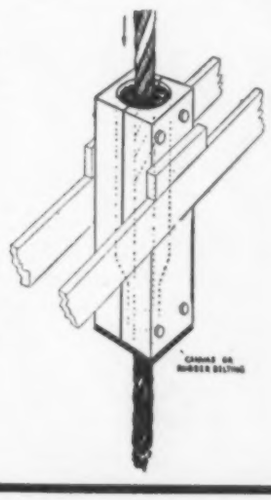


Figure 2 →



HOW TO MAINTAIN

Motor Starters IN STEEL MILLS

. . . . little time is required to take care of control equipment if a regular schedule is set up and adhered to . . . . five minutes spent in checking a starter may save five hours delay later . . . .

by M. J. Wohlgemuth
and L. E. Markle

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
EAST PITTSBURGH, PENNSYLVANIA

▲ IF the starter on your automobile is out of order, you immediately have a problem on how to get going. If your accelerator system (pedal, carburetor, etc.) is in bad condition, you cannot keep going even if you do get started. If your brakes are bad you cannot stop at the point you desire. Your motor control on the machines in your plant has the same importance as those items on your car. If you cannot start, accelerate or stop the motor, the value of the machine as far as production is concerned is little or nothing. A small amount of preventive maintenance will do wonders in doing away with costly delays due to failure of starters.

Satisfactory maintenance requires competent men and a thorough and adequate plan of handling the inspection and repair work. Good inspection and prompt repairs will avoid high maintenance costs; complete replacements will often be avoided; lost time will be kept at a minimum.

Preventive maintenance begins with the proper selection of the motor starter. If it is not suitable for the installation or if it has insufficient capacity, maintenance troubles are inevitable. The initial inspection of a new installation should be thorough and operation observed at load conditions before final acceptance is made. A time schedule for routine inspection should be established to meet the service requirements. As motors and their starters are always associated, a combined schedule can require inspection of both.

Oil and grease should never be applied to the bearings of a contactor or relay. Experience has indicated that oil or grease will cause dirt to accumulate and eventually result in a sticky, gummy accumulation that causes sluggish action. The bearings are designed with these requirements in mind and no lubrication is required on any part.

Bearing parts should permit contactors or relays to operate freely and without apparent friction. If parts are out of alignment and excessive friction does exist, it should be eliminated. Sluggish action will cause electrical troubles. Monthly inspections for severe service and semi-annual inspections for average service will do much to prevent bearing and friction troubles.

No bearings are required when the moving parts of a contactor or relay are relatively light and the magnetic forces can be made strong enough to lift the movable parts vertically to close the contacts. This is an ideal design as far as bearings are concerned. However, the moving parts must be guided within the solenoid and non-magnetic guides must be used to prevent magnetic sticking and sluggish action.

Although contacts are generally thought to be subjected primarily to electrical duty, the mechanical duty is equally important. Endurance tests are made with no current through the contacts to observe how well they withstand the pounding, rolling and sliding or scrubbing action that occurs every time the contacts close. Contactor designs often provide a rolling action of the contacts so that the circuit is closed and opened on the contact tips instead of on the closed contact position.

When high currents that are difficult to interrupt are expected, powerful arc rupturing structures are supplied to force the arc off the contacts and quickly extinguish it. These arc-rupturing structures are called arc boxes or blow-out structures. When in operating position they completely surround the contacts and must always be in correct position to rupture the arcs effectively. They are easily removed for inspection or replacement of contacts. They must be returned to proper position after inspection so that the arc will be properly broken and the contacts will not be unnecessarily worn and burned.

Contacts should be renewed when badly burned or pitted and when worn thin. They should be clean but need not be smooth. In fact, a clean contact with a roughened surface comparable to coarse sandpaper is a very satisfactory condition and provides as good, or better, contact surface than perfectly smooth surfaces. If a contact surface is pitted or burned and not worn thin it can be cleaned and used again.

The method of cleaning is important. Coarse and crude filing wastes material and generally deforms the original contact shape. The contact surfaces then have high spots and point contacts that are apt to overheat. Instead of filing, clean with sand-paper or by buffing wheel. A fine file is permissible if the contact shape is maintained. Emery paper should never be used, as particles may adhere to the surface and cause unnecessary wear.

Silver contacts seldom require cleaning. They may look black and dirty because of the silver oxide but as the oxide is a conductor, cleaning is not often necessary.

When contacts are replaced, the surface against which they are bolted should be thoroughly cleaned. This is usually a current-carrying joint and a clean contact bolted to a dirty surface can not give best results. Both surfaces should be clean. Any traces of copper oxide should be removed.

The screws or bolts that hold contacts in place must

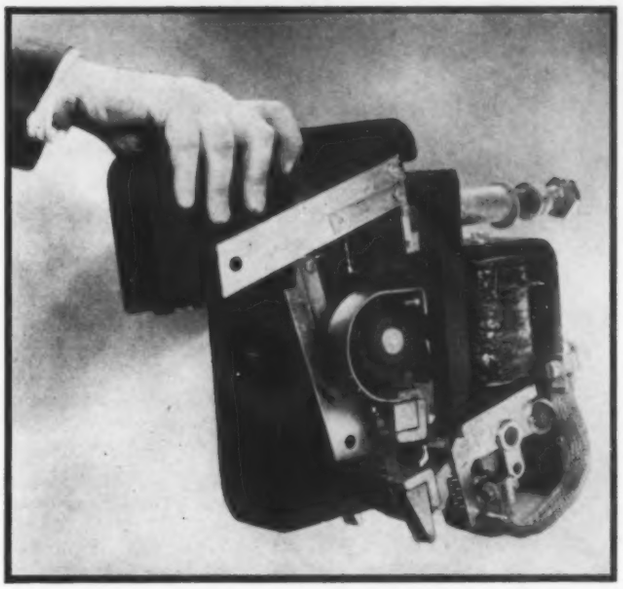


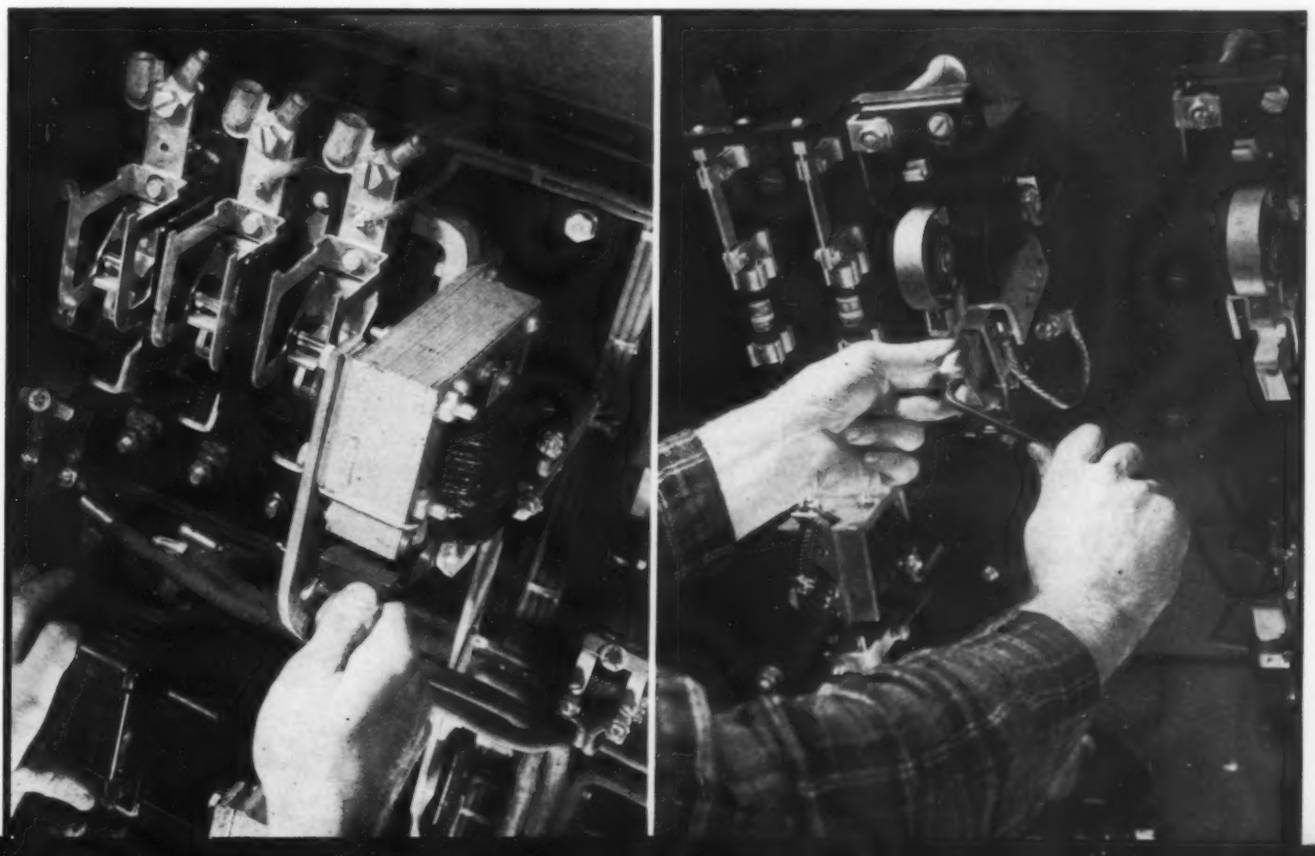
Figure 1 — Close-up view of d-c contactor. 1. arc box; 2. coil; 3. contacts; 4. bearings; 5. contact spring; 6. shunt. (top)

▲

Figure 2 — Moving parts of contactors and relays must move freely and without evidence of undue friction. Bearings are made for severe duty and should not be oiled or greased. (bottom left)

▲

Figure 3 — Contacts worn through by long use or badly burned contacts must be renewed. Surfaces against which contacts are bolted should be cleaned. Clean copper contacts, though slightly roughened are entirely satisfactory. Silver contacts, though black in appearance, need not be cleaned. Be sure contacts are tight at all times. (bottom right)



CHECK CHART FOR MOTOR STARTER TROUBLE

Trouble	Cause	What to do
Contactor or relay does not close.	No supply voltage.	Check fuses and disconnect switch.
	Low voltage.	Check power supply. Wire size may be too small.
	Open circuited coil.	Replace.
	Push button contacts not making.	Clean and replace if badly worn.
	Interlock or relay contact not making.	Adjust and replace if badly worn.
	Loose connection or broken wire.	Check circuit with "flash light" [turn off power first!]
	Overload relay contact open.	Reset.
Contactor or relay does not open.	Push button not connected correctly.	Check connections with wiring diagram.
	Shim in magnetic circuit* worn allowing residual magnetism to hold armature closed.	Replace.
	Interlock or relay contact not opening circuit.	Adjust contact travel.
	"Sneak" circuit.	Check control wiring for insulation failure.
	Contacts weld shut.	See "Contacts weld shut."
Contacts weld shut.	Insufficient contact spring pressure causing contacts to burn and draw arc on closing.	Adjust, increasing pressure. Replace if necessary.
	Rough contact surface causing current to be carried by too small an area.	Smooth surface and replace if badly worn.
Arc lingers across contacts.	If blow out is series it may be shorted. If blow out is shunt, it may be open circuited.	Look at wiring diagram and see kind of blow out. Check to see if circuit through blow out is all right.
	If used, arc box might be left off or not in correct place.	See that arc box is on contactor as it should be.
	If no blow out used, note travel of contacts.	Increasing travel of contacts will increase rupturing capacity.
Noisy a-c magnet.	Improper seating of the armature.	Adjust.
	Broken shading coil.	Replace.
Excessive corrosion of contacts.	Chattering of contacts as a result of vibrations outside of the control cabinet.	Check control pressure and replace spring if it does not give rated pressure. If this does not help, move control, so that vibrations are decreased.
	High contact resistance because of insufficient contact spring pressure.	Replace contact spring.
Abnormally short coil life.	High voltage.	Check supply voltage and rating of controller.
	Gap in magnetic circuit†	Check travel of armature. Adjust so that magnetic circuit is completed.
	Too high an ambient temperature.	Check rating of contact. Get coil of higher ambient rating from manufacturer if necessary.
Panel and apparatus burned by heat from starting resistor.	Motor being started too frequently.	Use resistor of higher rating.

*D-c only. †A-c only.

be tight at all times. A loose contact surface offers high resistance and develops heat. This causes increased oxidation of the copper contacts. As copper oxide is not a good electrical conductor, this oxidation creates still more resistance and heat. This action is cumulative and eventually causes melting of the contacts and deterioration of the entire contact assembly.

When contacts open and close, the rolling and rubbing action combined with the slight burning of a normal arc combine to keep the contacts bright and clean. If the contacts operate infrequently, the cleaning action does not occur and a covering of copper oxide develops. The heating-oxidation cycle may start and eventually overheating may develop even though the current or load is normal or less. For such conditions, silver contacts will probably give better service, as silver oxide is a good conductor and heating does not develop. Silver contacts may also provide some relief in cases where a small overload condition is troublesome. They must, however, be used with some caution because they will not correct overheating caused by loose connections. As silver has a lower melting tem-

perature than copper, silver contacts are more prone to become soft and "weld" or "freeze" together when subjected to high arcing temperatures.

Other special alloy materials are available that give reasonably good service under certain unusual or specific conditions. Contacts made of special materials should be used only on advice of the manufacturer of the device. Usually they are rated at lower current carrying capacities than similar contacts of copper or silver.

The closed pressure of contacts is an important factor in their ability to carry current. A small contact with suitable contact pressure will carry more current than a larger one with little or no pressure. Renewal of thin contacts is required, as with wear they lose their contact pressure. It is important to keep the contact springs in good condition. Replace them if they have been damaged or have lost temper through exposure to high arcing temperatures.

A monthly inspection of contacts for pressure, available life, surface condition, temperature and tightness should suffice for normal conditions. For severe operating conditions a weekly inspection may be advisable.

Shunts are generally flexible bands of woven copper strands that carry current from the movable contacts to a stationary stud. If the shunt is unduly bent its strands break and cause additional loading of the remaining strands.

Shunts with broken strands should be renewed to prevent overheating. The terminal connections of the shunt should be tight. Shunt ends are frequently silver plated or covered with special finishes to insure a clean contact surface of good current carrying ability.

After coils are wound they are treated with insulating varnish to improve their di-electric strength and make them a solid mass. This makes the coil less susceptible to mechanical injury, eliminates air pockets within the winding and enables the coil to radiate heat more readily than an untreated coil.

Alternating-current coils are designed to withstand 10 per cent over-voltage and operate the devices at 85 per cent of normal voltage. Direct-current coils will withstand 10 per cent over-voltage and operate devices at 80 per cent of normal voltage.

Figure 4 — Defective coils must be replaced. Designs are usually made so that coils may be changed easily and without much delay.

Over-voltage operates a contactor or relay with more mechanical force and tends to shorten the mechanical life if allowed to prevail. Over-voltage also shortens the life of a coil because it operates at a higher temperature. Low voltage will cause sluggish action. The contact tips may touch but may not be forced completely closed against the contact spring pressure. Under such conditions the contact tips will most certainly overheat and probably "weld" together. Contacts must always seal closed.

On a-c service the coil current is much higher while the contactor is closing than after it is closed. A-c coils are not designed to stand the open-gap or closing current continuously. If any mechanical interference prevents complete closure of the magnetic air-gap of an a-c device, its coil will soon be over-heated.

Open-circuited coils are easily detected because they cannot operate the device. A voltmeter connected across the coil terminal would show zero voltage. A coil with some turns short circuited might operate, but it would soon over-heat and burn out. Most designs permit quick and simple replacement of a defective coil.

When a magnetic contactor opens, the movable part strikes the stationary stop rather forcibly. There is a "dead", or center of percussion, point at which the effect of the blow is nullified. If the striking occurs at some other point the device is subjected to mechanical vibrations and strains that reduce its mechanical life. This feature is vividly illustrated by the "sting" of a baseball bat if the ball strikes near the end.

Figure 5 — Arc shields must be in correct position. A misaligned arc shield will seriously decrease the arc interrupting ability of the entire blow out structure and may interfere with the opening and closing of the contactor.

D-c contactors always operate quietly when closed. A-c contactors may be noisy. The laminated magnetic structure, necessary on a-c designs, must be held tightly together by screws, rivets or other means. If the laminations become loose the assembly will be noisy.

Noise will also result if the movable and stationary pole pieces do not fit well together when the device is closed. Dirt or rust may prevent proper closure of these surfaces and cause objectionable noise. To prevent rust on these fitted surfaces during shipment some grease is applied. The excess grease should be removed when placed in service to eliminate a "sticking" or sealing effect when the surfaces are first closed against each other.

The most important device in reducing noise of an a-c device is the shading coil usually imbedded in a part of the laminated magnetic structure. This coil is often a single turn of wire or strap and if broken the noise will be most objectionable. If a contactor is noisy, look first for a broken shading coil.

For high-voltage installations, in explosive atmospheres and areas of corrosive nature, such as acid fumes, the entire equipment is often completely immersed in oil. The oil should be maintained at proper level and should be kept clean, especially when used for insulating purposes. A monthly inspection of oil immersed equipment is adequate unless service is so severe that the oil deteriorates rapidly.

"Explosion tested" starters are intended for use in explosive atmospheres and do not require oil. These starters are built to specifications of the Underwriters' Laboratories. The enclosing cases are built to withstand high pressures that occur within the case if internal explosions should occur and to prevent flames escaping into the explosive atmosphere. If dismantled, the parts of an explosion tested starter must be carefully assembled to be sure that all bolts, nuts and joints are tight. Operation in the explosive area, unless properly and completely assembled, is not permitted.

When oil or any liquid is used in dashpots, regular inspections should be made to be sure that the dashpots are free of friction and the proper oil level is maintained. The liquids used in dashpots are tested for certain characteristics such as change in viscosity with temperature changes. A change in oil or liquid would therefore affect the operation of the relay. No substitution of oil or liquid used in dashpots should be made.

Thermal relays are subject to ambient temperatures and should be in a room temperature equivalent to that in which the motor is located. Otherwise the relays may not operate to the best advantage. For example, a thermal overload relay should not be in a temperature much in excess of the motor room temperature unless proper allowance for the difference in temperature is made when the thermal heaters are selected.

Loose connections are a frequent cause of trouble.

Figure 6 — Contact pressures are very important and should be checked. Weak springs and overworn thin contacts will reduce contact pressures.

Figure 7 — The working parts of dashpots are machined to small clearances. They should be kept clean. Parts should move freely without friction. Correct liquid should be used and liquid level should be maintained.

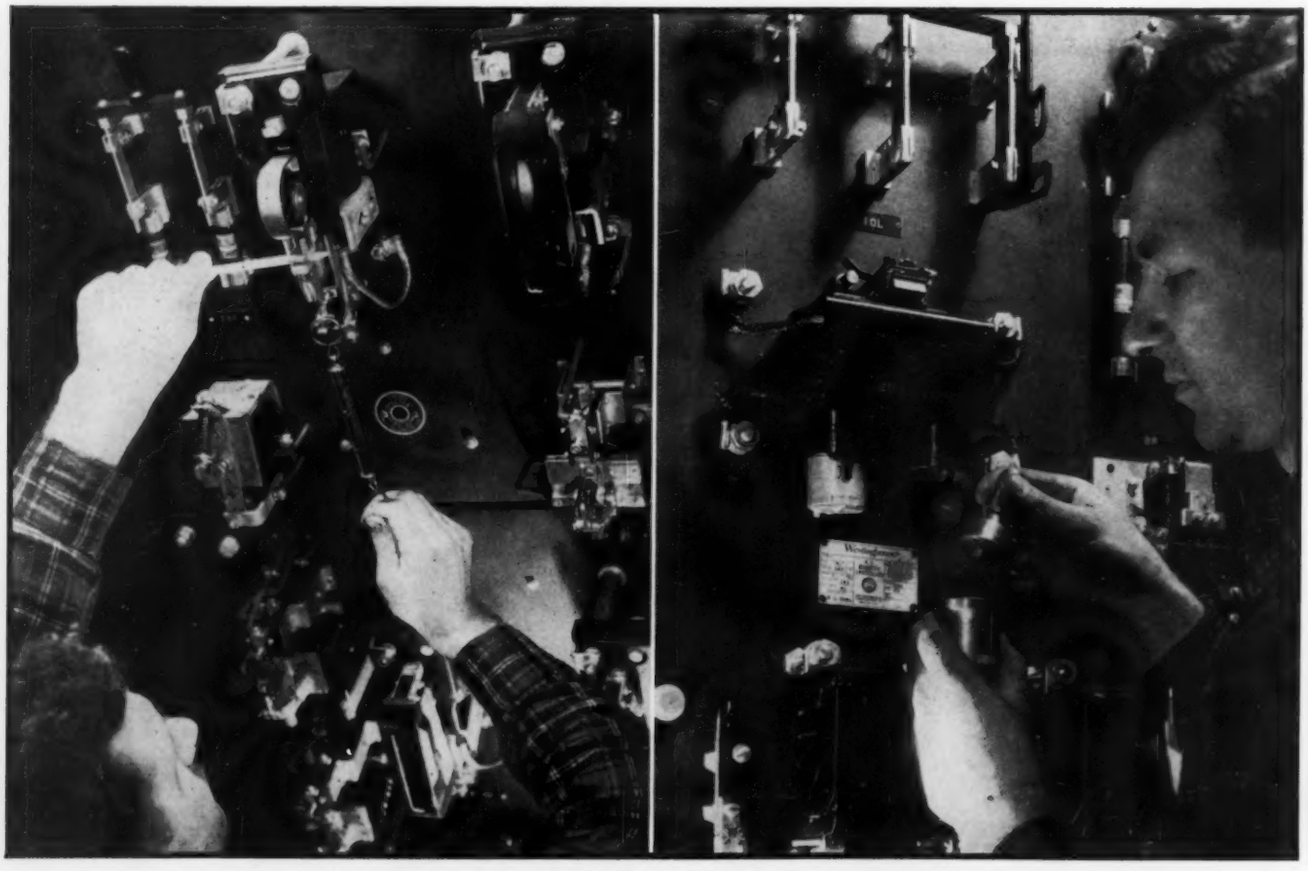


Figure 8 — All connections must be kept tight at all times. Loose connections are a frequent but very elusive cause of operating troubles.

They result in overheated parts that eventually must be replaced. Once tight does not mean they will remain tight. Periodic inspection is necessary. Changes in temperature, vibration and carelessness are all common cause of poor connections. They should always be tight and clean.

Resistors frequently fail from excessive temperatures. Overheating may be caused by insufficient ventilation, excessive current or more continuous service than was anticipated in the design. Loose connections often cause local heating with eventual burned connectors. Grid or cast types sometimes break in handling or with frequent and sudden overheating and cooling.

Moisture, dirt and dust are constant sources of trouble as they reduce insulation values of insulated wires and cables. They constitute a leakage path across which breakdowns occur between points of different potentials that would never occur on clean and dry surfaces. Routine maintenance should remove dirt and dust by blowing with dry compressed air, or wiping or washing with suitable cleansing fluid. Compressed air under too much pressure may drive metallic dust and dirt into insulation or lodge particles between stators and rotors of motors or in moving parts of contactors and relays.

Moisture may occur from condensation, humid atmospheres, spray or overhead dripping. Heaters are sometimes placed in enclosures to keep the interiors dry. They are generally arranged to be automatically effective when the equipment is idle because the normal heat of resistors and coils is sufficient while in operation. Drip-proof, water-tight and dust-tight enclosures may be provided.

Moisture in conduits is a frequent source of grounds. Grounds cause false circuits that cause unexpected starts, prevent stopping by normal means, eliminate overload protection and cause unsatisfactory operation. Any measures to prevent moisture in conduits are good insurance against trouble. When serious grounds develop they are eliminated by cleaning the conduit and installing new wiring. The insulation resistance should be checked regularly so that the presence of grounds can be detected and eliminated before trouble occurs.

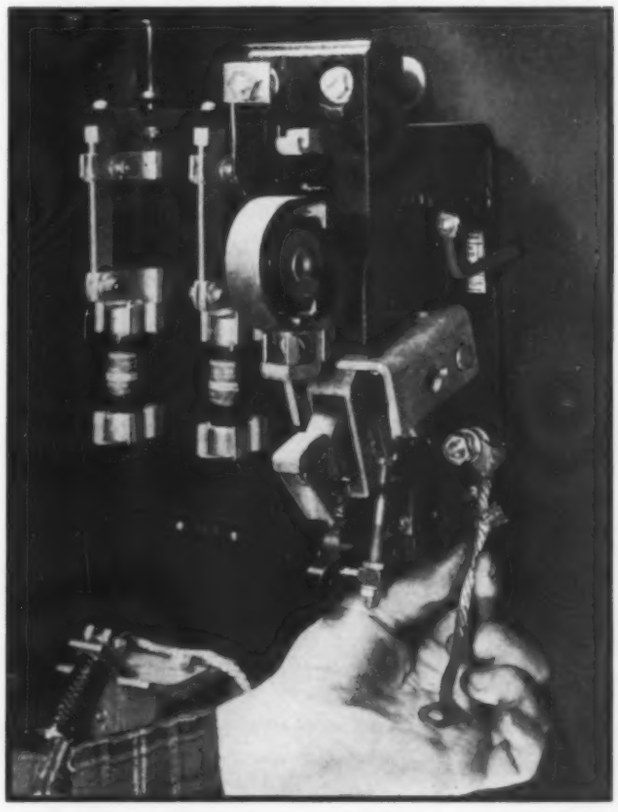
All wiring should be kept in safe and good condition. Vibration will cause broken wires. Oil, moisture, dirt and grease cause insulation breakdowns. Chafing or rubbing against unprotected edges soon wears away all insulation at that point. Temporary wiring is hazardous. Nuts and lock nuts should be tight. Defective wiring is an outstanding cause of electrical trouble and fires. Regular inspection is necessary.

High temperature is a sure sign of trouble. However, one must be sure that the temperature is excessive. To touch a cabinet or coil or motor and decide it is too hot is not a safe procedure because safe operating temperatures are often higher than one can comfortably "feel" with the hand. The best procedure is to know what temperature is considered safe and then actually measure it.

Here are the high-points that should be checked to keep motor starters in good operating condition. They must be free of oil, dirt and moisture. No oil should be used on contacts or bearings of contactors and relays. Connections should be tight and wiring should be safe. Movable parts of contactors and relays must move freely and without friction. Contacts should be clean and tight with correct pressure and not worn too thin. Arc-rupturing devices must be in operating position.

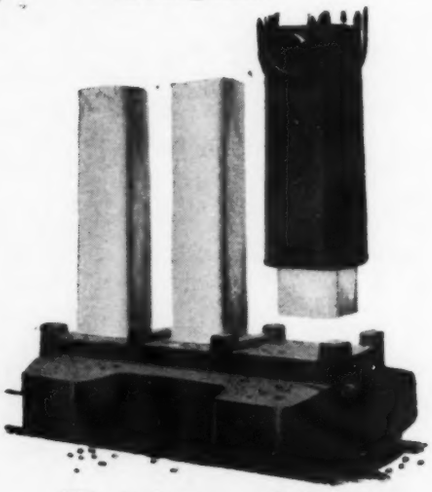
From a study of the above maintenance points it can be seen that the amount of time necessary to take care of control equipment, such as starters, is not great if a regular schedule is set up and adhered to. Five minutes spent in checking a starter that seems to be functioning properly may save five hours delay later.

Figure 9 — Broken strands of shunts cause the remaining good strands to carry more current and eventually overload the shunt and cause it to overheat. Damaged shunts should be renewed.

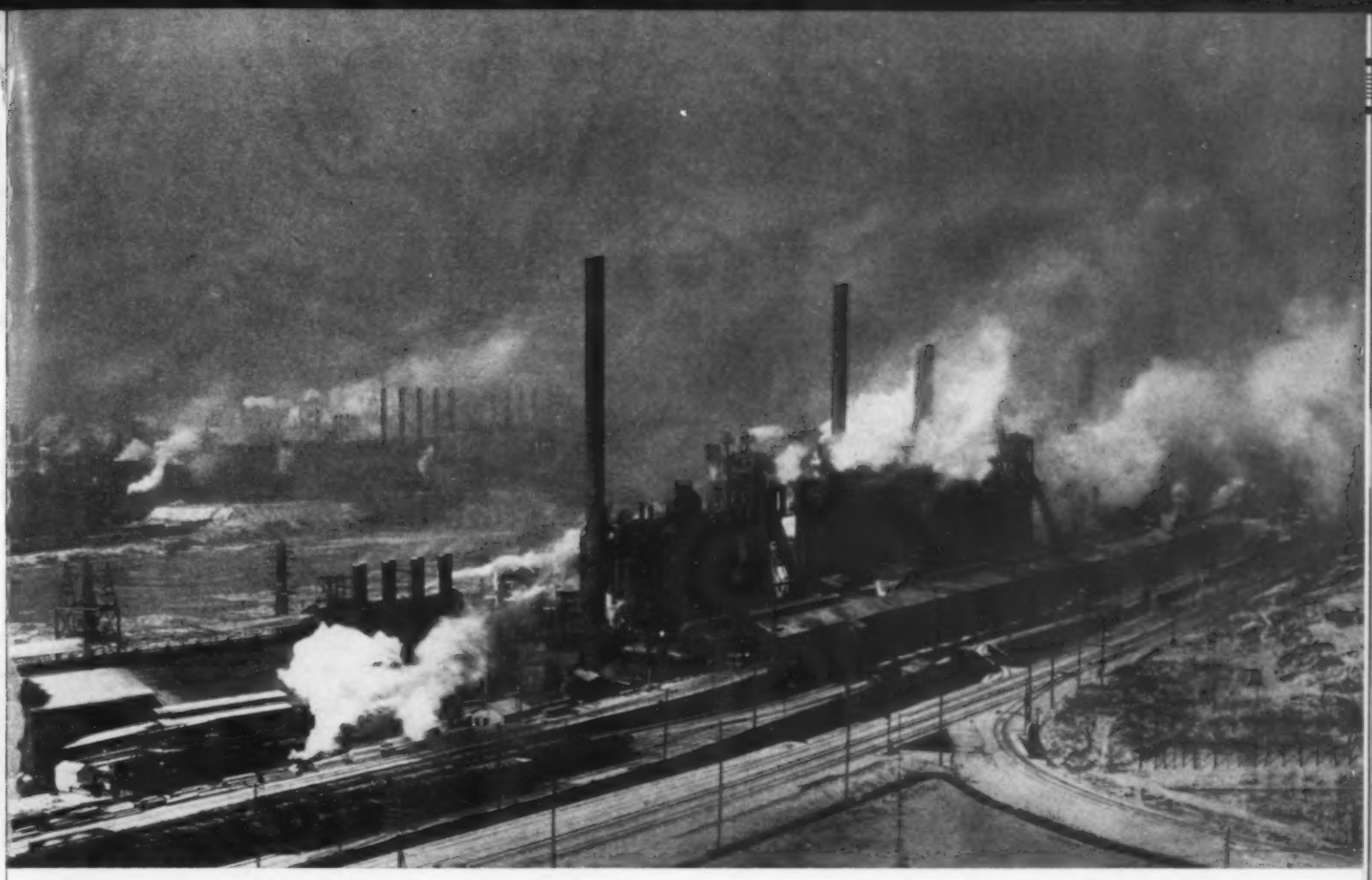


When the ingot sticks in the mold during the stripping operation, then lets go, severe shock loads are imposed on the journal bearings of the ingot car. The fact that more than 75% of the ingot and charging cars throughout the country are Hyatt Roller Bearing equipped indicates how well Hyatt Bearings have proven their ability to function under the most severe conditions in all types of steel mill equipment. When you design or purchase new equipment or make change-overs you will be sure of reduced maintenance charges and fewer production interruptions when Hyatt Roller Bearings are used. Call in the Hyatt man on all friction problems.

HYATT BEARINGS DIVISION GENERAL MOTORS CORPORATION
HARRISON, NEW JERSEY



This is just one of the many tough applications of Hyatt Roller Bearings in steel mill service.



JONES AND LAUGHLIN STEEL CORPORATION PHOTO

Program

Annual meeting and engineering conference

ASSOCIATION OF IRON AND STEEL ENGINEERS

William Penn Hotel • Pittsburgh, Pennsylvania

September • 25 • 26 • 27

Monday, September 25

9:00 A.M. — REGISTRATION — Silver Room.

Chairman:
J. D. JONES
Chief Engineer
Youngstown Sheet and Tube Company
Youngstown, Ohio

Vice-Chairman:
G. H. ROSE
Assistant to Vice President
American Steel and Wire Company
Cleveland, Ohio

9:15 A.M. — BUSINESS SESSION — Urban Room.

Chairman:
CHAS. L. McGRANAHAN
Assistant General Superintendent
Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania.

Secretary:
F. H. DYKE
Assistant General Manager Steel Plant
Wheeling Steel Corporation
Steubenville, Ohio

9:30 A.M. — ELECTRICAL DIVISION — Urban Room.

Chairman:
J. H. MILLER
Electrical Superintendent
International Harvester Company
Wisconsin Steel Works
Chicago, Illinois

Vice-Chairman:
R. W. GRAHAM
Electrical Superintendent
Bethlehem Steel Company
Lackawanna, New York

"An Improved System of Electrical Drives for Cranes," by M. A. Whiting and J. A. Jackson, Industrial Engineering Division, General Electric Company, Schenectady, New York.

"Selection and Maintenance of Magnetic Brakes," by A. E. Lillquist, Supervising Engineer, Engineering Department, Cutler-Hammer, Inc., Milwaukee, Wisconsin.

Symposium — "Communication Systems in Steel Plants," by Whitney Hayes, Branch Manager, Tel-Autograph Corporation, Pittsburgh, Pennsylvania. F. C. Millard, Sound Engineer, Modern Sound Systems, Pittsburgh, Pennsylvania.

1:30 P.M. — MECHANICAL AND WELDING DIVISION — Cardinal Room.

Chairman:
F. C. SCHOEN
Plant Engineer
The Midvale Company
Nicetown, Philadelphia, Pennsylvania

Vice-Chairman:
T. R. MOXLEY
General Master Mechanic
Wheeling Steel Corporation
Steubenville, Ohio

"Welding and Cutting Applications in Steel Plant Maintenance," by S. D. Baumer, Applied Engineering Dept., Air Reduction Sales Company, New York, New York.

"Alloy Steels for Maintenance in the Steel Plants," by J. A. Rosa, Metallurgical Department, Republic Steel Corporation, Massillon, Ohio.

"Maintenance With Low Temperature Welding," by R. D. Wasserman, President, Eutectic Welding Alloys, Inc., New York, New York.

1:30 P.M. — OPERATING PRACTICE DIVISION — Urban Room.

Chairman:
A. S. GLOSSBRENNER
General Superintendent
Youngstown District
Youngstown Sheet and Tube Company
Youngstown, Ohio

Vice-Chairman:
R. H. GELDER
Works Metallurgist
American Rolling Mill Company
Ashland, Kentucky

"The Unitemper Mill," by M. D. Stone, Manager, Development Department, United Engineering and Foundry Company, Pittsburgh, Pennsylvania.

"Shearing Flat Rolled Steel," by F. E. Flynn, District Manager, Republic Steel Corporation, Warren, Ohio, and D. A. McArthur, Chief Engineer, Wean Engineering Company, Warren, Ohio.

"The Place and Effect of Conveyor Equipment in Industry," by J. E. McBride, Vice President, Palmer-Bee Company, Detroit, Michigan.

Symposium — "Cleaning of Steel for Subsequent Coating," N. E. Cook, General Superintendent of Galvanizing, Wheeling Steel Corporation, Wheeling, West Virginia.
Joseph J. Duffy, Jr., Development and Service Engineer, Special Chemicals Division, Pennsylvania Salt Manufacturing Company, Philadelphia, Pennsylvania.
Joseph Greenberger and Lane Johnson, Jr., Development Department, United Engineering and Foundry Company, Pittsburgh, Pennsylvania.

8:00 P.M. — Motion Pictures, selected subjects — Urban Room.

Tuesday, September 26

9:00 A.M. — ROLLING MILL DIVISION — Urban Room.

Chairman:
LOUIS MOSES
Superintendent, Rail Mill and Roll Department
Bethlehem Steel Company
Sparrows Point, Maryland

Vice-Chairman:
F. G. KREDEL
Superintendent, Bar Mills
Republic Steel Corporation
Cleveland, Ohio

"Salvaging Forged Alloy Steel Rolls," by H. L. Watson, Jr., Superintendent, Special Products Department, The Midvale Company, Nicetown, Philadelphia, Pennsylvania.

"Structural Mills and Structural Mill Roll Design," by Ross E. Beynon, Superintendent Roll Shop Department, Carnegie-Illinois Steel Corporation, South Chicago, Illinois.

"Billet Preparation for Rolling Mills," by F. F. Cambest, General Foreman, Steel Supply and Preparation, Jones and Laughlin Steel Corporation, Pittsburgh, Pennsylvania.

1:30 P.M. — COMBUSTION DIVISION — Cardinal Room.

Chairman:
E. E. CALLINAN
Combustion and Refractory Engineer
Steel and Tube Division
Timken Roller Bearing Company
Canton, Ohio

Vice-Chairman:
J. J. ALEXANDER
Assistant Power Superintendent
Republic Steel Corporation
Cleveland, Ohio

"The Problem of Reversing Regenerative Furnaces," by J. P. Vollrath, Industry Engineering Department, and J. R. Green, Manager Steel and Ceramic Division, Brown Instrument Company, Philadelphia, Pennsylvania.

"Developments in Rotary Hearth Furnaces," by J. H. Loux, Salem Engineering Company, Salem, Ohio.

"The Continuous Determination of Oxygen and Combustibles in Furnace Flue Gases," by John F. Luhrs, Research Department, Bailey Meter Company, Cleveland, Ohio.

1:30 P.M. — ELECTRICAL DIVISION — Urban Room.

Chairman:
E. L. ANDERSON
Electrical Superintendent
Bethlehem Steel Company
Johnstown, Pennsylvania

Vice-Chairman:
L. R. MILBURN
Electrical Engineer
Great Lakes Steel Corporation
Ecorse, Detroit, Michigan

"Increasing the Power on Existing Cold Mills," by F. R. Burt, Industrial Engineer, and B. J. Auburn, Electrical Engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania.

"The Electronic Frequency Changer," by A. G. Darling and L. W. Morton, General Electric Company, Schenectady, New York, and F. W. Cramer, Electrical Engineer, Carnegie-Illinois Steel Corporation, Pittsburgh, Pennsylvania.

"Blast Furnace Skip Hoists," by Gordon Fox, Vice President, Freyn Engineering Company, Chicago, Illinois.

7:00 P.M. — INFORMAL STAG DINNER — Ball Room.

Speakers:
George P. Comer and Dr. Henry Gerald.
Presentation of the first annual John F. Kelly award.

Wednesday, September 27

9:00 A.M. — OPERATING PRACTICE DIVISION — Urban Room.

Chairman:
W. H. COLLISON
Superintendent, Coke Plant, Blast Furnace Division
Great Lakes Steel Corporation
Ecorse, Detroit, Michigan

Vice-Chairman:
H. W. CAMPBELL
Plant Engineer
Interlake Iron Corporation
Toledo, Ohio

"Gas Turbines for Blast Furnace Blowers," by Paul R. Sidler, Electrical Engineer, Brown, Boveri & Company, Limited, New York, New York.

"Design and Operation of Modern Sintering Plants," by C. J. Duby, Chief Engineer, Warren District, Republic Steel Corporation, Warren, Ohio.

"Performance of Large Hot Blast Stoves," by B. B. Frost, Service Engineer, Arthur G. McKee Company, Cleveland, Ohio.

1:30 P.M. — COMBUSTION DIVISION — Urban Room.

Chairman:
L. N. McDONALD, Jr.
Chief Power and Fuel Engineer
Carnegie-Illinois Steel Corporation
Youngstown, Ohio

Vice-Chairman:
C. J. WYROUGH
Superintendent, Steam Efficiency and Combustion Department
Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania

"Blast Furnace Gas— Wet-Washed or Dry Cleaned?" by Frank X. Gilg, Service Department, The Babcock and Wilcox Company, New York, New York.

"New Open Hearth Furnaces at Homestead," by H. J. Pugsley, Engineer, Swindell Dressler Corporation, Pittsburgh, Pennsylvania.

Round Table Discussion — "Disposition of Coke and Blast Furnace Gas."

Harold C. Cox, Superintendent, Steam and Combustion, Bethlehem Steel Company, Johnstown, Pennsylvania.

Paul Leiss, Combustion and Steam Engineer, Republic Steel Corporation, Warren, Ohio.

Robert A. Lytle, Assistant Superintendent, Maintenance Steam and Power, Carnegie-Illinois Steel Corporation, Clairton, Pennsylvania.

H. B. Helm, Assistant Superintendent, Fuel Department, The Youngstown Sheet and Tube Company, Youngstown, Ohio.

1:30 P.M. — LUBRICATION DIVISION — Cardinal Room.

Chairman:
C. E. S. EDDIE
Lubrication Engineer
Great Lakes Steel Corporation
Ecorse, Detroit, Michigan

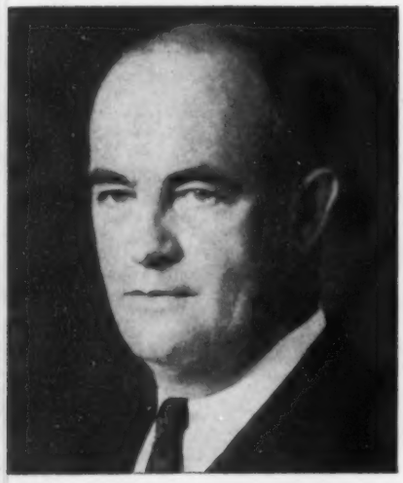
Vice-Chairman:
S. C. GRIFFITH
Lubrication Engineer
Jones and Laughlin Steel Corporation
Pittsburgh, Pennsylvania

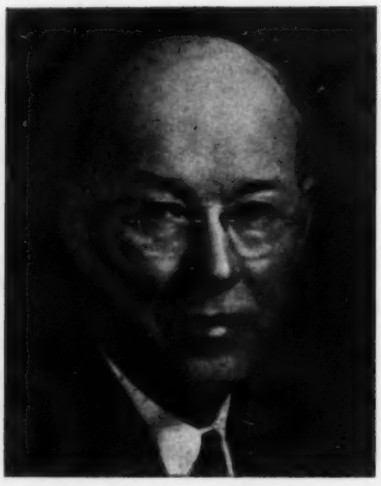
"Use of Demulsifiers in Circulating Oil Systems", by T. G. Roehner and E. S. Carmichael, Socony-Vacuum Oil Company, Brooklyn, New York.

"Additives in Oil for the Steel Plant," by C. E. Pritchard, Lubrication Engineer, Republic Steel Corporation, Cleveland, Ohio.

"Current Developments in Industrial Lubricants and Their Influence on Post-War Products," by G. F. Bowers, Standard Oil Company of Indiana, Chicago, Illinois.

PRESIDING OFFICERS *and* AUTHORS





J. D. Jones
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F. C. Schoen

T. R. Moxley
A. S. Glossbrenn
Louis Moses

M. D. Stone
D. A. McArthur
F. E. Flynn

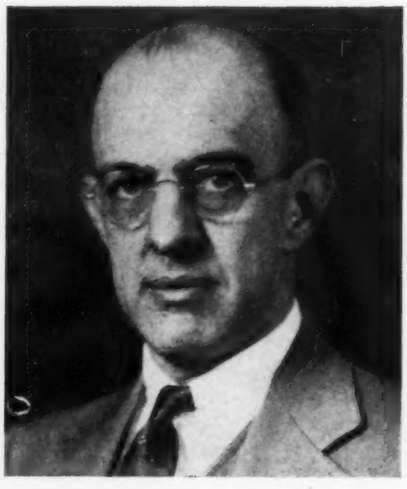
R. E. Beynon
F. R. Burt
C. J. Duby

Nelson E. Cook
C. J. Wyrough
C. E. S. Eddie

E. E. Callinan
L. R. Milburn
W. H. Collison

J. J. Duffy
G. F. Bowers
F. F. Cambest

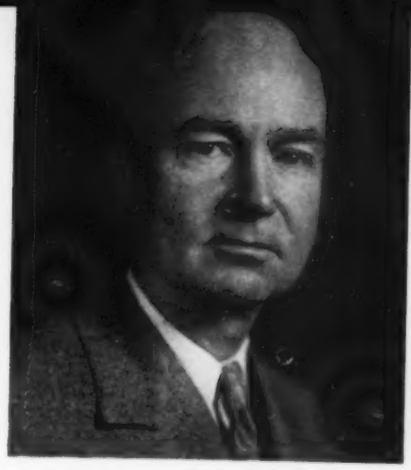
F. X. Gilg
H. L. Watson, Jr.
J. P. Vollrath



A. E. Lillquist
C. E. Pritchard
F. W. Cramer

P. R. Sidler
S. D. Baumer
S. C. Griffith

J. E. McBride
T. G. Roehner
R. H. Gelder



E. L. Anderson
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E. S. Carmichael
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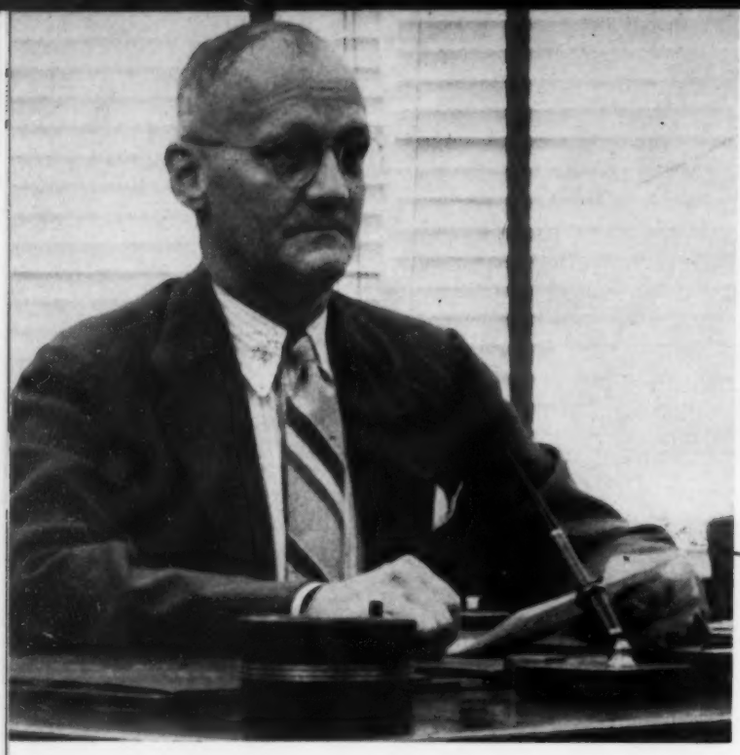
H. W. Campbell



To the Steel Industry

As the time nears for what we hope will be the last wartime engineering conference of the Association of Iron and Steel Engineers, the iron and steel industry can look back over a truly enviable record of production achievement — a record that might, at the start, have been thought impossible — a record made in spite of the handicaps imposed by strikes and the shortages of manpower and certain materials.

But in looking back at our achievements we must not allow our forward momentum to slacken. There is still the matter of finishing the war, and no war can be won by the glories of the past. You cannot kill the enemy by throwing the history book at him. It takes fighting and the materials of war — and that means production.

There is another reason for keeping our sights trained forward, and, at the risk of being accused of "home front complacency," I might say one almost as important as finishing the war. I refer to the post-war period.

There is no doubt that steel will be faced with competition much more severe than in pre-war days. Greatly expanded capacities for the production of aluminum, magnesium and brass will give a peacetime surplus which will seek to cut in on steel's markets, to say nothing of the developments in plastics. Furthermore, our expanded steel capacity will tend to eliminate the inefficient producers.

Thus the steel industry faces a definite post-war problem — one that calls for the exercise of just as much ingenuity and resourcefulness as do our production problems. We cannot pause for self-congratulatory reminiscence, but must think and plan now for peacetime production, even as we continue wartime production.

To this end we have devoted a portion of the technical program of our annual engineering conference, and I wish to extend an invitation to the engineering and supervisory personnel of the iron and steel industry to participate in this meeting. Through such meetings we have in the past contributed very materially to production accomplishments and we feel that the results merit continuation of these activities.

Chas. L. McGranahan

PRESIDENT

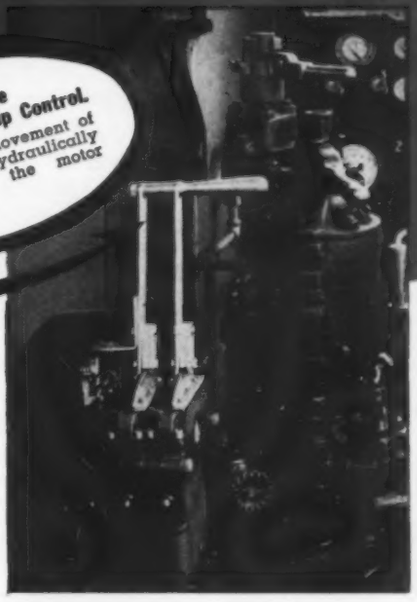
PORTER—DIESEL-ELECTRIC Switchers

and now—

FINGER-TIP CONTROL

- POSITIVE
- ACCURATE
- INSTANTANEOUS

This is the PORTER Finger-Tip Control.
The slightest movement of the throttle is hydraulically transmitted to the motor speed control.



To the progressive refinements constantly being incorporated in PORTER Diesel-Electric Switchers we now add FINGER-TIP CONTROL.

Utilizing the hydraulic principle of transmitting motion, PORTER'S Finger-Tip Control assures accurate synchronization of motors, and positive, instantaneous response to the slightest movement of the throttle lever in the cab. Finger-Tip Control eliminates troublesome rods, cables, pulleys, and turnbuckles, with their tendency to lost motion, back lash, and need for constant adjustment. Complete description and photographs on request.

ARMY E NAVY

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Established 1866

LOCOMOTIVE DIVISION: Diesel, Diesel-Electric, Electric, Steam, and Fireless Steam Locomotives.

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PITTSBURGH, PENNSYLVANIA
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Maintenance and Lubrication

FROM THE TIMKEN ROLLER BEARING COMPANY

▲ ROLLER bearings are sold on the basis of a definite life expectancy. The maintenance problem for those designed to last as long as the machine, gears, etc. is comparatively simple. They must be mounted correctly, well enclosed, and properly lubricated at regular intervals.

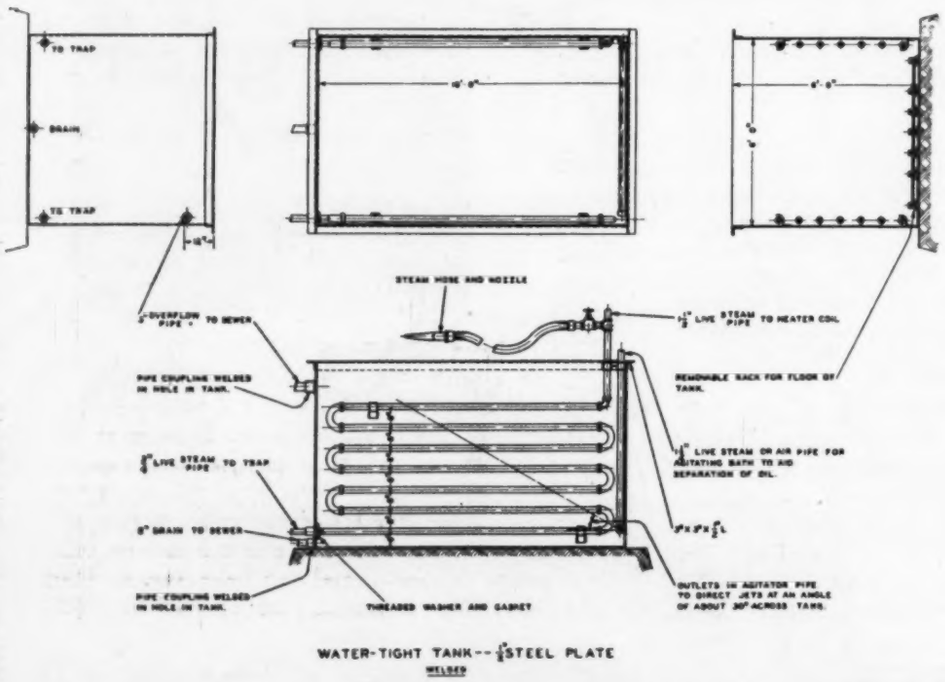
Once a year it is advisable to flush out the bearings in equipment in this group with kerosene or light machine oil to wash out any sediment which may have collected. Likewise, if the machinery is to be shut down for any length of time, it is advisable to remove the lubricant from the bearings and replace it with fresh grease or oil. This will eliminate the possibility of moisture or foreign matter which might have been in the old lubricant settling out and causing pitting or corrosion.

In the case of bearings for units subject to frequent change the problem is entirely different. Although it would be possible to make roll neck bearings which would have almost unlimited life, it would not be economical. Such bearings would, in most cases, be excessive in size and would require equally large rolls, involving a large increase in capital investment. Consequently, most roll neck bearings are selected on the basis of an average life, ordinarily 15,000 hours of operation in the mill.

Different factors must be used in selecting bearings for hot and cold mills because of the differences in mill operation. It should not be expected that a bearing which will last 15,000 hours in a hot mill will give an equal length of service in a cold mill. This will be readily appreciated when the cycle of operations in a hot mill is compared with that of a cold tandem or reversing mill. Further, it should be remembered that cold mills are usually pre-loaded to take the stretch out of the mill housings, which results in more constant and greater loadings on the cold mill bearings than is the case in hot mills.

Careful maintenance is essential in developing maximum bearing life. Provision should be made to shift roll neck bearings from one stand to another at intervals so that all bearings will operate approximately the same length of time in the high speed and slow speed stands. When loading is not equal in all stands of tandem cold mills it is likewise advisable to shift the bearings at intervals to distribute the work evenly on all the bearings. If each bearing and chock is numbered. it is comparatively easy to keep an accurate record of the bearing in each chock as well as the various locations in the mill where the chock has been used and the number of hours in each location.

Every bearing should be given a thorough inspection at intervals of from 3 to 6 months, depending upon the type of service. To do this properly it is recommended that a washing tank such as is shown in the accompanying sketch be installed. This tank should be large enough to allow the complete chock and bearing assembly to be submerged and thoroughly cleaned. A satisfactory cleaning solution may be made by using three or four ounces of trisodium phosphate per gallon of water. The



Sketch showing details of washing tank. Tank should be large enough to accommodate complete chock and bearing assembly. A sodium phosphate solution gives satisfactory results.

solution should be kept agitated while the bearing is in the tank by means of live steam.

Before a roll neck bearing is removed from the chock, the position of the cups or outer races with reference to the load zone should be noted or marked. This is important, since the cups do not rotate and consequently the load is concentrated on a comparatively small section of these races. By rotating the cups 90 degrees when they are reinstalled in the chock, a new load zone is established, which serves to prolong the life of the bearing to a considerable degree.

If signs of spalling should be noted during inspection, the spots should be touched up with a dental grinder and the cup rotated 90 degrees to take the spalled area out of the load zone. In the event that spalling is extensive, it is advisable to return the bearing to the manufacturer for repair.

BEARING REPAIRS

Inspection may reveal that a number of rolls in a bearing are spalled to such an extent as to require replacing. This may be done at the mill with the assistance of the bearing company representative, or the entire bearing returned to the manufacturer for repair. If the spalled rolls are to be replaced at the mill, they should be removed from the cage and with them one good roll from each roll assembly, shipping them to the bearing manufacturer. The good roll will enable the manufacturer to make the necessary precise measurements required to turn out new rolls of the exact size required. Each roll assembly is marked to designate the size of the rolls, and it is important that replacement rolls be reassembled in their proper position.

A bearing is seldom found to be a complete failure except when it has been in a wreck or has passed its expected life. Consequently, periodic inspection and repair serves to prolong the total life of the bearing and keep costs down to a minimum.

Better Care FOR ROTARY COMPRESSORS AND VACUUM PUMPS

▲ COMPRESSORS, like other machines, are now working many times the hours they did in peacetime . . . which puts correspondingly greater responsibility on the maintenance man. Here are some hints for insuring maximum life:

If a machine has been out of operation for some time, disassemble it and clean it thoroughly before again putting it into service. Dirt inside compressor will increase wear and interfere with the best functioning of the lubrication system.

When starting a compressor for the first time, turn rotor by hand to make sure that it is free and that direction of rotation is the same as indicated by the arrow on the machine. The lubricating pump should be cranked by hand until all oil lines are filled. Make certain that cooling water is circulating in jacket . . . compressors have been "burned up" through carelessness on this score.

Use a good grade of lubricating oil, with the specifications recommended by the compressor manufacturer. Do not allow the oil level in force feed lubrication systems to fall below the gauge glass in the pump.

Inspect bearings monthly, flushing them with a thin oil at this time (oftener, if required).

Check cooling water temperature at the outlet daily if a thermostat is provided; every 2-3 hours otherwise. If this temperature is below 85 F, too much water is flowing through the cooling system. If temperature rises above 100 F, either too little water is flowing or the machine is operating inefficiently. In either case, operating clearances for which machine was designed will not be maintained.

Important: Inspect intercooler and water jackets regularly to make sure that they do not become clogged with sediment. When jackets in a two-stage compressor are not kept clean, the machine may become overheated . . . with improper clearances the result. If the intercooler is clogged, the air entering the second stage may have so high a temperature as to cause breakdown of the lubrication system, and overheating of the bearings. Since formation of sediment on cylinder or jacket walls will prevent normal transfer of heat from the cylinders to the circulating water, temperature of the water at the outlet is not a complete check on cooling system efficiency.

If air intake passes through an oil filter, change the filter oil as required by location . . . more often in dusty atmospheres. A clogged filter will increase the pressure ratio through the machine because of poor vacuum between the suction of the compressor and the filter.

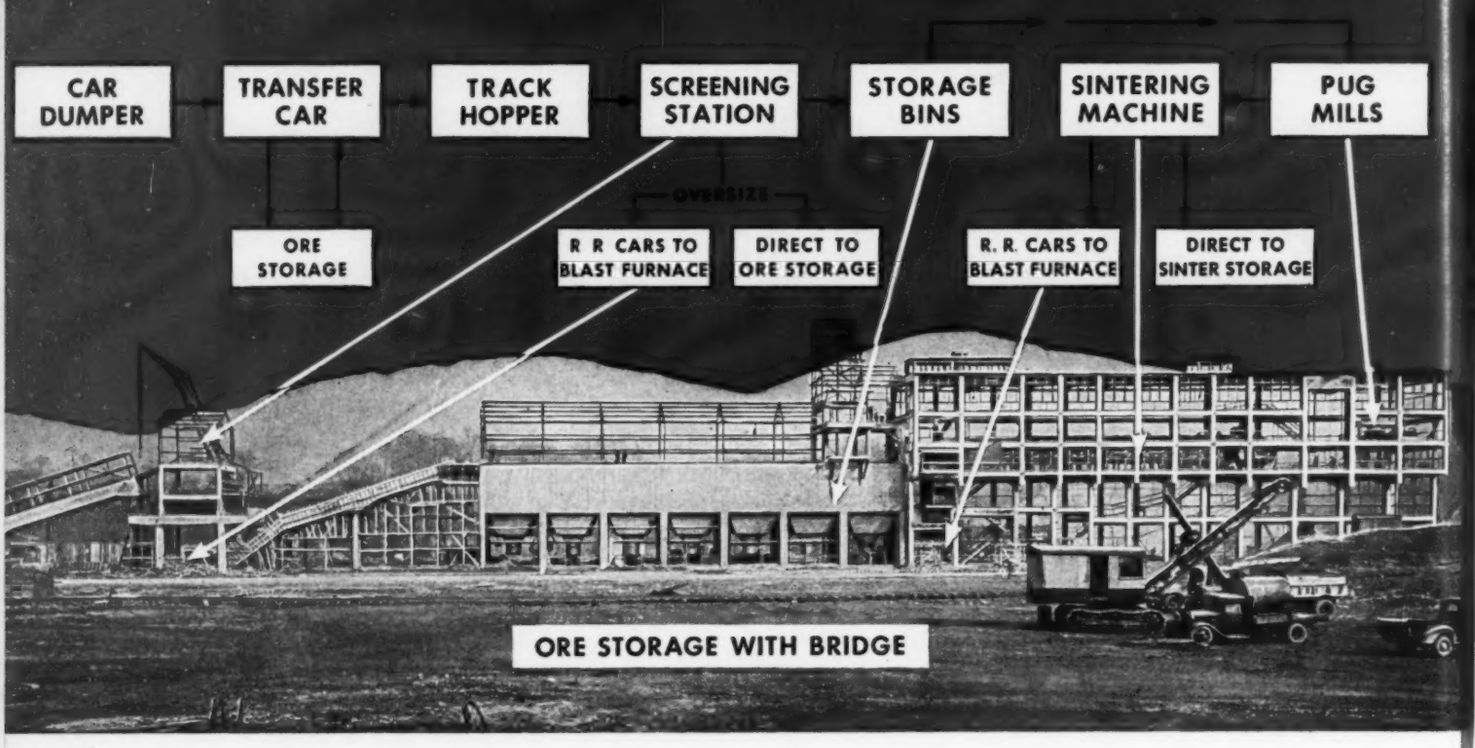
Once a year, take the machine completely apart for inspection. Particularly note wear on blades. If wear has cut blade width by as much as one-fourth, blades are in danger of breakage.

Check at intervals for any misalignment which may have developed between compressor and motor. If possible, use a dial indicator and gap gauge to check axial and parallel coupling alignment. Tolerances should not exceed .005 in.

From the Allis-Chalmers Operation and Maintenance Review, March-April, 1944.

Modern Screening and Sintering Plant

Designed and built by Arthur G. McKee & Company for Wheeling Steel Corporation



THE photograph reproduced above shows a modern sintering plant under construction by McKee for Wheeling Steel Corporation. This plant was completed and placed in operation in July.

As indicated by the accompanying flow sheet this plant is built on a simple, straight-line design and provides complete facilities for ore handling and preparation including ore yard, car dumper and storage facilities. The sintering machine is 6′ wide by 89′3″ long and has 14 windboxes.

The design of this plant is based on a complete study of raw materials, blast furnace requirements and seasonal shipment and storage of ores. Since all materials are received in railroad cars an analysis and flow sheet of all car movements of each ore during shipping and winter seasons was necessary.

Construction of buildings is entirely of concrete to comply with wartime restrictions. Simplicity and ruggedness of plant and equipment have been emphasized throughout.

Arthur G. McKee & Company

★ *Engineers and Contractors* ★

2300 CHESTER AVENUE • CLEVELAND, OHIO

ROCKEFELLER PLAZA
NEW YORK, N. Y.

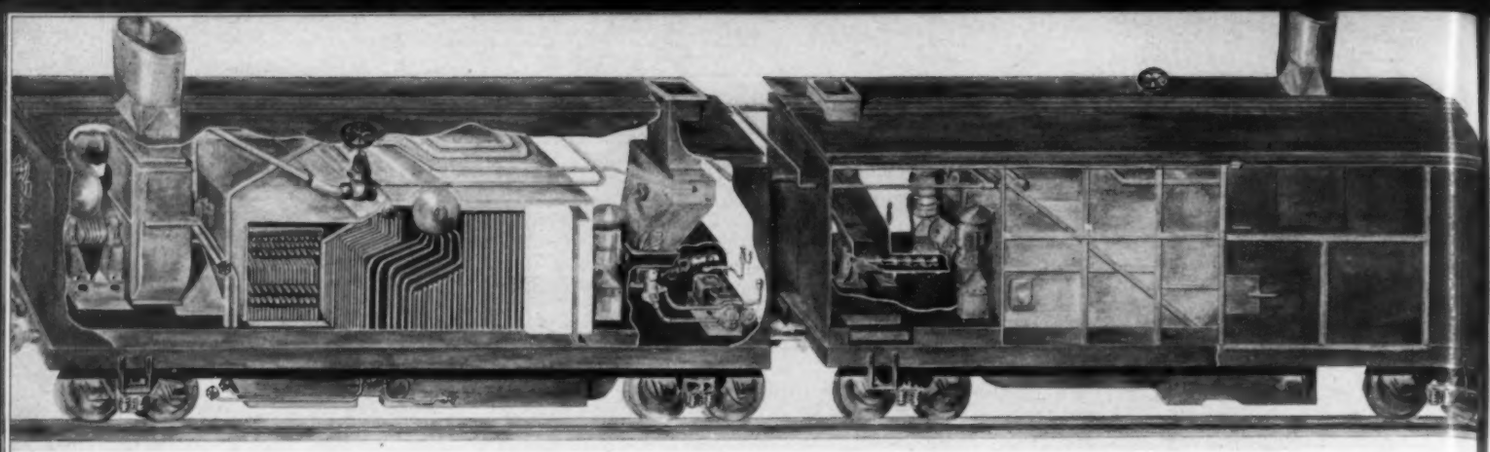
COMMERCE BUILDING
HOUSTON, TEXAS

Mobile Steam Power Plants

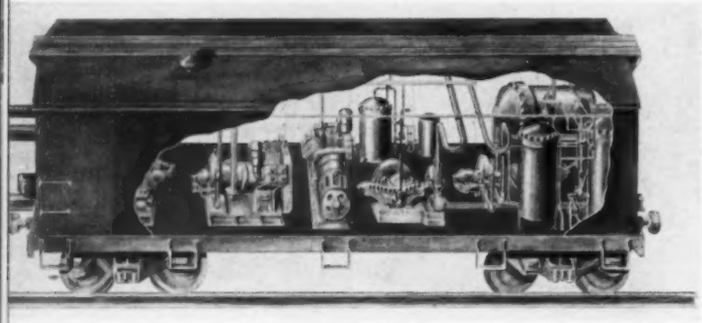
For use in war-torn areas abroad, the United Nations will soon have mobile electric power generating plants, completely self-contained and built on specially designed railroad cars. Westinghouse Electric and Manufacturing Company is now building ten 5000 kw power trains and twenty-four 1000 kw trains. The accompanying illustrations show a 5000 kw unit which consists of 8 cars. All of these cars are shown in the cut-away drawings except the 10,000 gal insulated storage car for boiler feed water and the combination car which provides a work shop and living quarters for the operating crew.

The 1000 kw train consists of only three cars.

View taken from coal tipple which feeds 10 tons of low-grade coal to the boilers. The stack in the foreground is on one of the two boiler cars. Next is the water storage car, followed by the auxiliary power car, the turbine car and two condenser cars with exhaust stack covers in open position.



Each of the two boiler cars contains a 40,000 lb per hr, two-drum, bent tube, water wall boiler designed for 660 psi gauge, 750 F. Each boiler is provided with a superheater, an economizer, soot blowers, a locomotive type stoker, two 9900 cfm motor driven forced draft fans and one 46,000 cfm motor driven induced draft fan. Soot blowers and stokers are air operated to minimize the amount of make-up water required. Full rating output can be produced even when using low grade lignite of 7300 Btu per lb.

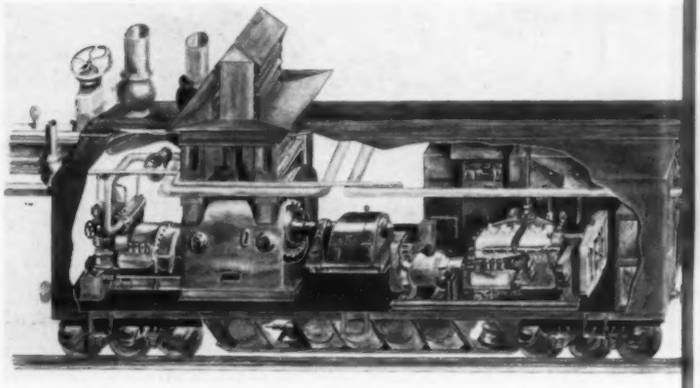


The auxiliary power car contains the following equipment: Two turbine driven centrifugal boiler feed pumps, each rated at 208 gpm of 200 F feed water against a 1770 ft head.

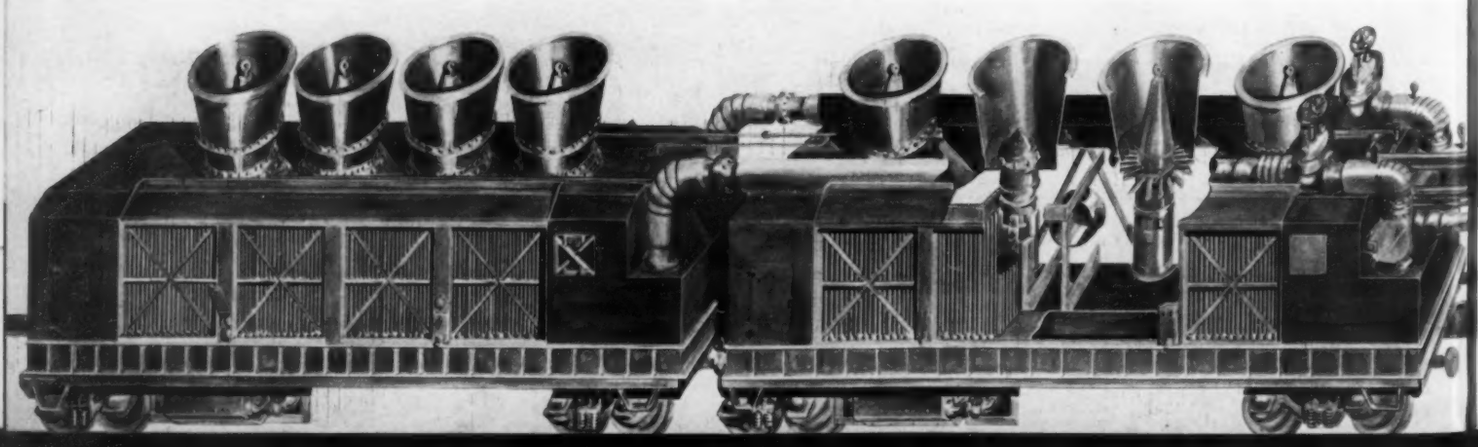
One evaporator unit (including a deaerator) to provide 2400 lb per hr of 32 F makeup water, together with the necessary equipment for water treatment.

Three 400 cfm air compressors, one motor driven and two turbine driven, together with air storage tank, water cooling tower and pump. The air is used to operate the boiler stokers, coal spreaders and soot blowers.

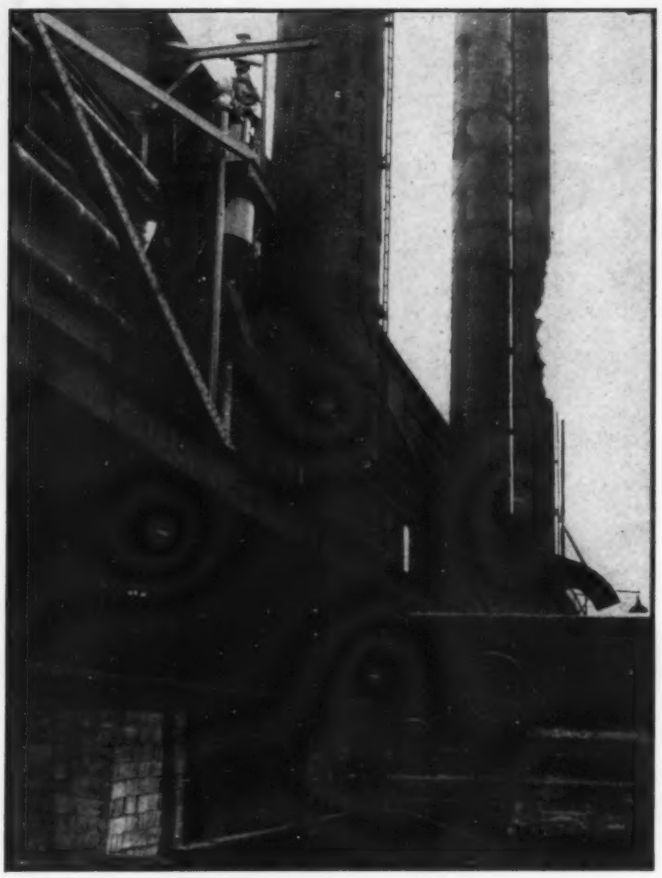
The main turbo-generator is rated at 6250 kva at 80 per cent power factor and delivers power at 6300/10,900 volts, 50 cycles. The turbine is designed for steam at 600 psi, 750 F, operates at 3000 rpm and exhausts at 2 psi gauge. In the same car is a 750 kva air-cooled transformer which supplies power for the train auxiliaries at 380/220 volts, 3 phase, 50 cycle. For starting up operations, a 93.8 kva, 75 kw, 380/220 volt, 4 wire, 50 cycle generator, driven by a diesel engine, is provided. Switchgear is metal clad and totally enclosed.



Two condenser cars contain the main steam condensing unit in which air is used as the cooling medium. Eight condensing sections and four blowers are installed on each car. The condensers are formed of galvanized steel fire tubes. The entire unit is designed to condense the exhaust steam from the 5000 kw turbine at a maximum back pressure of 2 psi, gauge, when cooled by air at temperatures of — 40 F to 95 F. The condenser has a total tube surface of 10,500 sq ft and a total fire surface of 90,000 sq ft. When condensing 80,000 lb of steam per hr, the temperature of the 800,000 cfm of cooling air passed through the condenser is raised 90 degrees F. Each car is equipped with a single stage ejector and an air-cooled after-condenser. The prime function of the condenser is the recovery of condensate.



WANT TO *Save Manhours?*



This 48 in. x 84 in. Vacuum unit MODEL 106X installed in an Ohio valley steel plant serves six 150 ton open-hearth furnaces, removing dust from checkers and flues with man-hour savings of 60 per cent. This is but one typical case of 29 units installed and on order.

Cleaning checkerwork, slag pockets, flues, gas mains . . .

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R Y E R S O N

Abstracts of Papers . . .

To be read at A. I. S. E. Annual Meeting, Pittsburgh, Pa., September 25-26-27, 1944

STRUCTURAL MILLS AND STRUCTURAL MILL ROLL DESIGN

By Ross E. Beynon
Superintendent, Roll Shop Dept.
Carnegie-Illinois Steel Corporation
South Chicago, Illinois

This paper describes in a brief way some of the early types of mills used for rolling structural shapes, and also some mills now producing shapes. An interesting foreign mill design is also described, which has some novel features.

The part on roll design will describe several of the ways in which standard beams, channels, angles, and zee bars are rolled, and the advantages and disadvantages of the various designs.

Designs of some of the various miscellaneous sections produced on structural mills will be illustrated also.

A brief description of roll material used will be included.

DESIGN AND OPERATION OF MODERN SINTERING PLANTS

By C. J. Duby
Chief Engineer, Warren District
Republic Steel Corporation
Warren, Ohio

The expansion program for steel industry as a contribution to the war effort and sponsored by the War Production Board included sintering plants at various locations throughout the country having an approximate capacity of 10,771,000 net tons annually, which it was felt would increase the annual output of pig iron by approximately 851,000 net tons which is equivalent to approximately two additional blast furnaces. Five of these sintering plants built for the Defense Plant Corporation were assigned to Republic Steel Corporation, having a total rated capacity of 2,189,000 net tons per year, and they were distributed among five of Republic's districts.

The type of sintering machine selected was what is commonly known as the continuous pallet conveyor with ignition furnaces over the bed. The various ores and various screened sizes having definite sintering characteristics was the factor in determining the square feet of effective wind box area and size, as well as the type and capacity of suction fan. The wind boxes, down legs, collecting mains, dust catchers and dampers were designed to assure the minimum of resistance and turbulence to the flow of waste gases. All of these plants have some basic design mechanically but had to be given special consideration in the matter of handling and conveying the raw material. Port Henry mine ores lend themselves admirably to concentration and sintering to produce excellent open hearth charge ore. Experience proves that sinter in the blast furnace burden will increase pig iron production and decrease coke consumption.

The design and operation of sintering plants has been the subject of much engineering concern in the industry and there are numerous cases which did not prove satisfactory. The continuous pallet conveyor type sintering plant has been in successful operation at the Corrigan-McKinney plant of Republic Steel Corporation in Cleveland for a number of years and this plant was taken as a guide in designing the five new sintering plants. Careful consideration had to be given to the amount of flue dust produced which depended on the number of blast furnaces and in addition consideration

had to be given to sintering fine ores. The carbon content of flue dust is ideal for sintering fine ores and gives the operator a means of balancing carbon content in the feed to the sintering machine and enabling him to secure a uniform product. Both of these are usually available at all blast furnaces. Consideration also had to be given to minimumizing the amount of dust in the building especially in connection with the electrical and mechanical equipment.

The paper will contain a full description of these sintering machines explaining in detail and will note that an attempt was made to do everything possible to make the plant continuous in operation. The storage bins filled during the day have ample stock to operate for the remainder of the 24-hour period. From the description, it will readily be seen that the design is compact and arranged to allow for flexibility and variable control. In order to establish good practice and low maintenance costs and obtain a quality product, it will be necessary, however, for the operators to give this equipment their undivided attention.

WELDING AND CUTTING APPLICATIONS IN STEEL PLANT MAINTENANCE

By S. D. Baumer
Applied Engineering Department
Air Reduction Sales Company
New York, New York

During the last several years the imperative need for maximum steel production has imposed upon mill maintenance departments new tasks and burdens which have brought home to all steel makers the potential possibilities of welding and oxyacetylene cutting in solving the all-important problems of plant maintenance.

Unlike many other types of industrial companies, steel mills have always been largely self-dependent in doing their own construction and repair work. But with the onset of the war, and increasingly as time went on, the mills were obliged to broaden the scope of their self-dependence even further, until today their maintenance programs are geared to cope with virtually any problem that may arise, regardless of whether it is an emergency or a routine matter. Many lessons can be, and are being, drawn from this experience.

Due to the complete lack of replacement parts and the remote delivery dates quoted for replacement, maintenance departments have been forced to use every ounce of ingenuity at their command to minimize serious production delays and to prolong and, if possible, increase the life of already overworked equipment. In this work the welding and cutting processes have unquestionably contributed a large share. Most important, however, is the fact that far greater progress has been made, and more knowledge accumulated, over the short span of the last few years, than could possibly have been accomplished in many more years of normal operations. Much has been learned, for example, about the proper designing of assemblies to be welded, to give them the required structural strength and yet conserve on critical materials. Likewise, there has been a broadening of experience in the proper selection of welding materials and materials to be welded, both in the fabrication of new parts and in the reclamation of worn or broken parts.

Steel mill maintenance departments deserve a great deal more credit than they usually receive for their achievements in enabling the mills to set wartime production records. While welding, cutting, and the allied oxyacetylene processes have served as major tools to these organizations, it is chiefly because of their intelligent and enterprising application of these processes that progress has been made. This was done under the added handicap of shortage of skilled help, and the consequent necessity to train new men and even women to replace those called into the armed forces.

In surveying the accomplishments of mill maintenance organizations it is unfortunate that in numerous cases it is impossible to obtain accurate and complete records. This is due partly to lack of adequate help in the mills for recording such data, and partly because jobs were done as a matter of course without recognition of the fact that there may have been something out of the ordinary about them. This latter tendency is one reason why the dissemination of information about these operations often lags too far behind the original solution to these problems. However, the volume of information available is considerable, and this paper describes numerous of the more significant maintenance jobs recently performed in various mills.

INCREASING THE POWER ON EXISTING COLD MILLS

By F. R. Burt
Industrial Engineer
and B. J. Auburn
Electrical Engineer
Westinghouse Electric and Mfg. Co.
East Pittsburgh, Pennsylvania

There is a natural desire on the part of most mill operators for more tonnage. On a cold mill the output may be increased by using higher accelerating rates, longer coils or higher threading speeds or by a study leading to the minimizing of lost motion on the part of the mill crew in handling the material. However, on a successfully operating mill any improvement obtained by the above means is apt to be small and an appreciable increase in output requires higher delivery speeds and therefore more power. In some cases it will be possible to obtain the desired increase with very little change in electrical apparatus. In others completely new apparatus will be required. It is necessary to treat each case as a separate problem, since in no two will the solution be the same.

On some mills the rated speed range is satisfactory, but certain heavy tonnage schedules cannot be rolled at as high a speed as desired without overloading the electrical equipment. Here it may be possible to increase

the continuous capacity of all or part of the motors by supplying more ventilating air or by supplying air at a lower temperature. This will require a refrigerating unit in series with the existing ventilating system. Compact self-contained units incorporating fans, compressor, coil and filters can be obtained in sizes up to 25 tons ice capacity, which will absorb approximately 90 kw of losses.

If it is impractical to increase the amount of air or to supply cooler air on account of space limitations, additional losses can be dissipated by allowing the air, and therefore the machine, to rise to a higher temperature. This will require class B insulation.

The above means of removing additional heat will only increase the continuous or rms capacity. It will not change the ability to commutate peak loads.

If the required increase is greater than can be obtained by additional heat removal or if the rated mill speed is to be increased by a nominal amount, it may be possible, particularly if the motors are not of recent design, to install different parts on the same bedplates, thus cutting down installation cost considerably. However, it will be necessary to supply more ventilating air in proportion to the increase in rating.

A large increase in mill speed will of course require completely new electrical apparatus. Limits of motor speeds may be exceeded on the finishing end, which will require the use of double armature motors, and in order to minimize the effect of inertia these armatures should be of as small diameter as possible.

SELECTION AND MAINTENANCE OF MAGNETIC BRAKES

By A. E. Lillquist
Supervising Engineer, Engineering Dept.
Cutler-Hammer, Inc.
Milwaukee, Wisconsin

Industry still faces the problem of unskilled operators for all types of machines, and also the question of satisfactory delivery of replacement parts. To insure trouble-free performance, new equipment must be carefully selected and both new and old equipment must be properly maintained.

The proper selection of magnetic brakes is not difficult if the requirements of the specific application are kept in mind. Brakes having a torque rating equal to full load motor torque are satisfactory for the majority of applications. However, if the load is overhauling and if the efficiency of the drive is high, a brake having a torque rating greater than full load motor torque is desirable, particularly if the machine may at times be overloaded. If the equipment must stop at a definite point on successive operations, the energy to be absorbed by the brake will determine the brake torque required. On those applications where the brake must stop a load more frequently than once a minute, or where the inertia of the machine is unusually high, the heat dissipating capacity of the brake should be checked.

The speed of operation required in the brake may determine the type of brake used. The speed of application and release of d-c brakes is more readily controlled than the speed of a-c brakes. The time required to stop a load by means of a brake can readily be calculated if data is available on the energy in the machine at full speed. However, it is important to take into account the time required for the brake shoes to apply after the brake coil is deenergized.

A brake may be properly selected and still give unsatisfactory performance due to inadequate maintenance, or improper adjustment. The importance of periodical inspection and proper maintenance and adjustment cannot be overstressed.

Brake wheels and linings go hand in hand. A lining which operates satisfactorily with one type of wheel may fail if used with another type of wheel. For that reason, best results may be obtained if the wheels and linings recommended by the brake manufacturer are used.

DEVELOPMENTS IN ROTARY HEARTH FURNACES

By J. H. Loux
Engineer
Salem Engineering Company
Salem, Ohio

There are over two hundred distinctly different rotary hearth furnace designs on the market today. A study of the five basic applications for rotary furnaces will give an answer as to why this type furnace has met with so much favor within recent years.

There is, first, the pan dumping rotary constructed with a hearth of hinged alloy tray sections. This unit has particular application where it is necessary to quench parts in small tray-load batches instead of continuously from a moving belt.

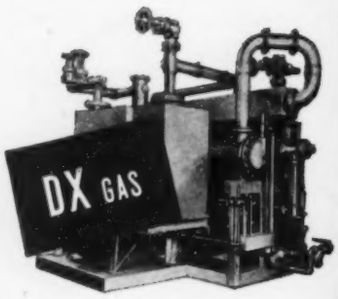
A second rotary furnace application has been made where it was desired to heat flat plates prior to their being formed hot on a press. The particular feature here was that by using a single door plus an especially designed charger unit, the loading and unloading problem was made entirely automatic.

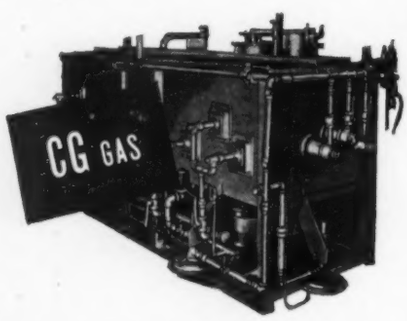
The rotary end heating furnace designed with a continuous sand seal, has proved that the ends of bars can be heated for forging with a minimum of scale. Further developments along this line have brought out fuel fired rotary units that can heat steel to forging temperature without any scale or decarburization whatsoever.

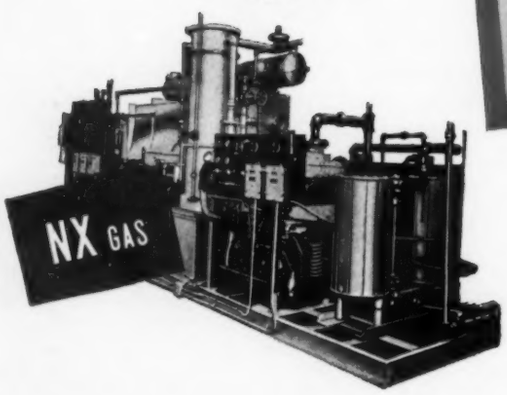
The fourth type of rotary considered is the standard forging furnace unit that has proved so successful in heating billets prior to their being forged into shells, cylinder liners and other parts. There are three important features to consider when selecting a rotary hearth furnace for heating billets: basic engineering details of construction; location of burners; and size of furnace.

Most piercing mills were originally installed with sloping hearth roll-down furnaces. These sloping hearth furnaces are now being replaced by rotary furnaces. The savings in manpower amounts to as much as six

(*Please turn to page 128*)







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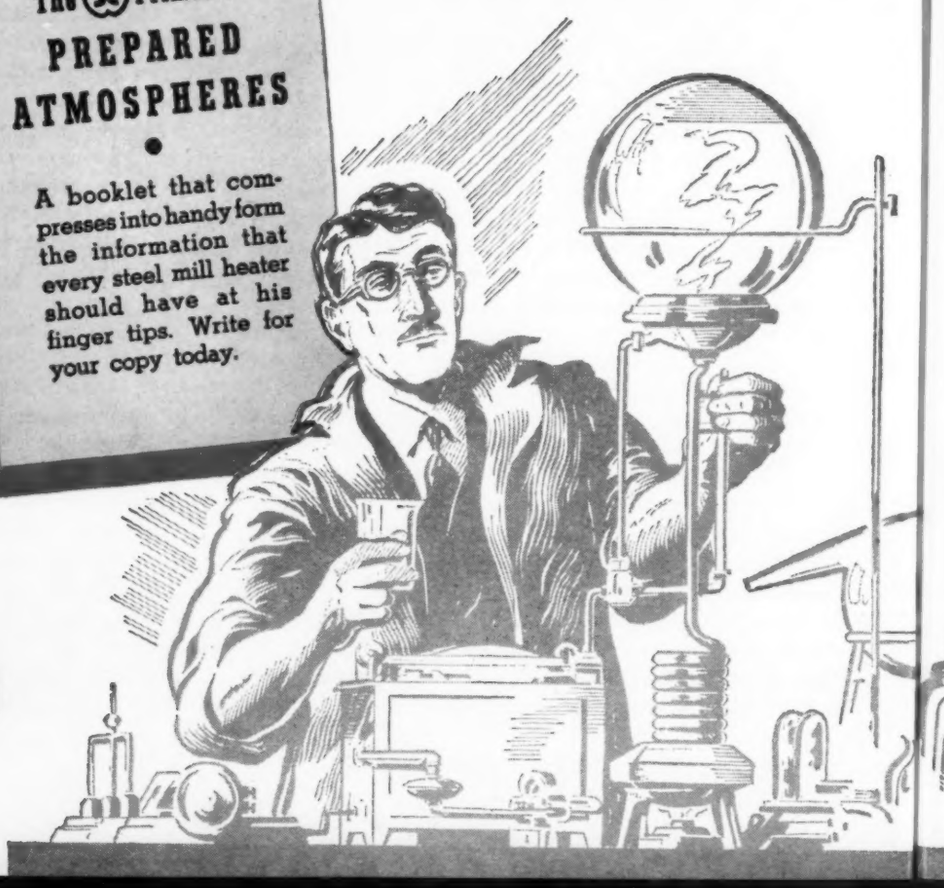

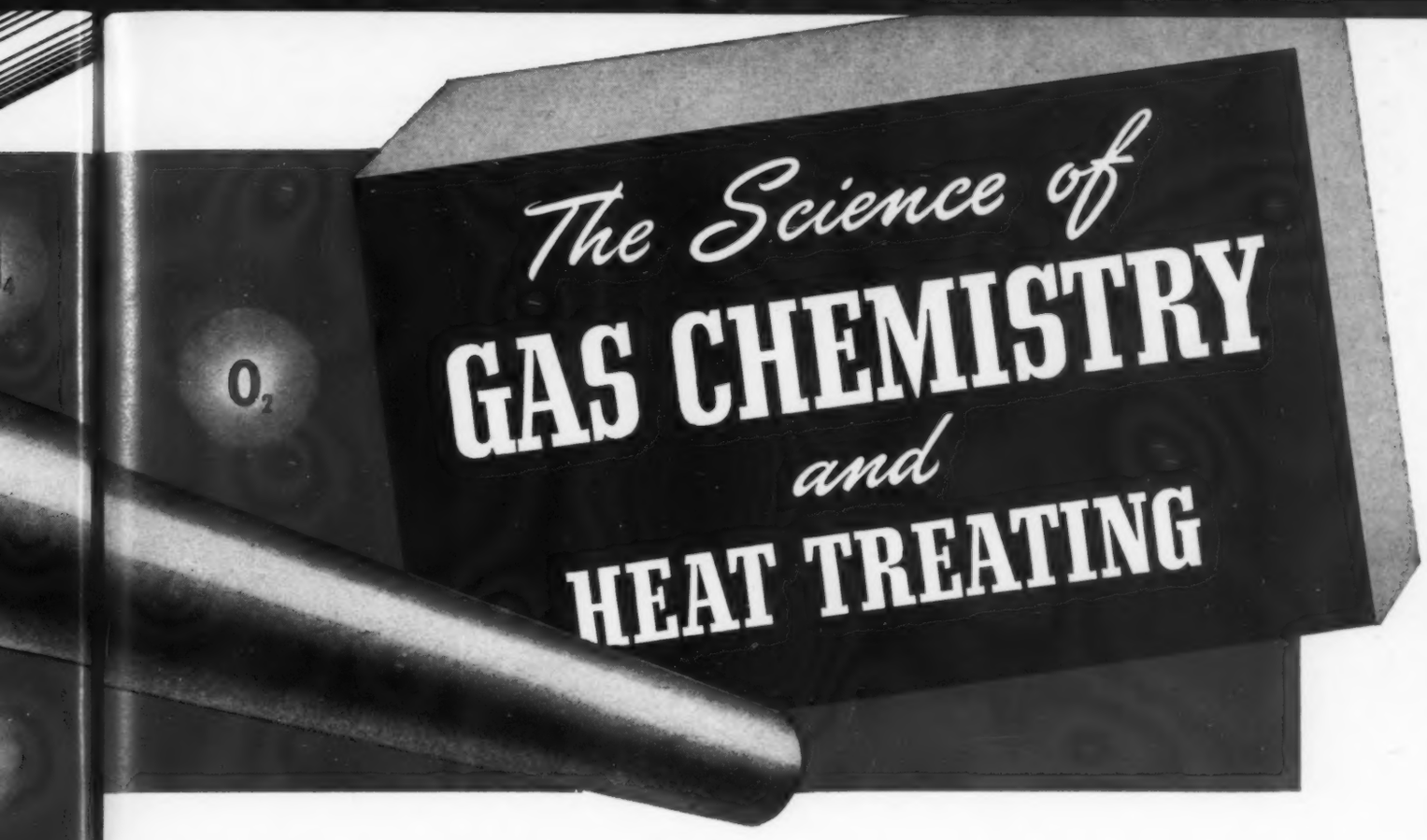

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In addition to these surface treatments, recent developments have shown marked effects of small amounts of gases within the physical structure of metals. Some of these gases are retained from the melting operation and some are entrapped during heat treatment. Some gases cling tenaciously to a metal surface just short of chemical union, while others are readily driven off into the surrounding medium. It is desirable to eliminate harmful reactions between metals and gases, and to develop superior metallurgical properties here-to-fore unknown. Gas quenching and dry pickling are recent outstanding Surface developments embracing the science of gas chemistry and heat treating, that have been industry proven. Other major developments are in the making.

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The rotary furnace is not the answer to all furnace problems. It may be loaded and unloaded from one convenient location, and it is inherently self-emptying. But, its most redeeming feature is its simplicity.

PERFORMANCE OF LARGE HOT BLAST STOVES

By B. B. Frost
Service Engineer
Arthur G. McKee Company
Cleveland, Ohio

This paper deals with the general aspects of the selection of stoves for a given duty cycle and in particular stresses the fact that the heating surface and brick mass of one stove is the controlling factor in any group of stoves.

Operating data from two plants are presented to show the gas burning rates which can be obtained on modern stoves and to indicate the performance that can be realized when using only two stoves of a group of three.

The general design factors which affect the gas burning capacity of a given stove are also covered.

THE PROBLEM OF REVERSING REGENERATIVE FURNACES

By J. P. Vollrath
Industry Engineering Department
and J. R. Green
Manager, Steel and Ceramic Division
Brown Instrument Company
Philadelphia, Pennsylvania

A comprehensive summary of reversal principles and methods is presented from the standpoint of fundamental operation, types of furnaces, desirable objectives, methods of temperature measurements, and comparisons between various methods of reversal operation.

Differences are shown between the requirements for continuous heating furnaces, such as billet heaters; batch type heaters, such as soaking pits; and batch type high temperature melting furnaces, such as the open hearth, with principal emphasis being given to the latter type of furnace.

Various methods of measuring temperatures and temperature gradients are discussed, as they apply to these types of furnaces in securing the desired objectives.

A discussion is presented on the comparative advantages and limitations of reversal methods as based upon time, "temperature difference," "maximum temperature," and "preheat drop" principles. Suggestions and recommendations are offered for selection of the proper systems for specific types of furnaces. Schematic diagrams of reversal systems, as well as tabulations of these operating characteristics and conditions under which reversal occurs, are shown as supplements to the text.

SHEARING FLAT ROLLED STEEL

By F. E. Flynn
District Manager
Republic Steel Corporation
Warren, Ohio
and D. A. McArthur
Chief Engineer
Wean Engineering Company
Warren, Ohio

Contrary to the belief of many people, shearing is a fairly modern art. Very little reference can be found to shearing of any kind in ancient writings. The first known reference is the use of chisels; later scissors were developed, and only within the last 100 years did shearing, as we know it in steel mills, take shape.

The figures for power and force required to shear metals with straight bladed shears can be given with a considerable degree of confidence.

The formula for rotary shearing cannot be stated with as great a degree of confidence, and for this reason a large number of actual tests were made on rotary shears in an effort to present some valuable data to use in designs. Tests included spot tests made on various side trimming and slitting lines when processing standard material, which happened to be on the line at the moment the people making the tests visited the plant. Such tests are naturally rather limited in scope.

Further tests were made at the Republic Steel Corporation plants in Warren and Niles under identical conditions on various gauges and types of steel and on several different machines. Curves showing these tests are included and show some interesting results.

Additional tests were made on two side trimming units of different size when set up for test purposes only. Oscillographs were used to obtain the most accurate possible readings on voltage, current and speed. Steel having similar analysis and hardness was sheared at various speeds. Some of the curves obtained from this data were remarkably smooth, and besides giving valuable information as to power required for rotary shearing, illustrated that a special test setup is essential if accurate data is to be obtained.

In one of these tests, similar power readings were taken on a scrap chopper.

In connection with side trimming and slitting, it is important that good setup be obtained, and good operating procedure be followed, to obtain the best possible results.

It is realized that procedure in different plants varies considerably, and that some of the practices described may not be acceptable as the best possible by every one. Criticism and discussion of practices will be very welcome.

One of the principal points of this argument may be as to whether material should be pulled through the rotary knives, or whether power should be applied to the knives. In general, it appears that with proper equipment and proper operation, good results can be ob-

tained on all classes and gauges of material when power is applied to the knives, but on certain gauges and classes of material equal, or nearly equal, results can be obtained by applying no power to the knives and pulling the material by means of the reel. If good results can be had in this manner the first cost of the equipment is less, and a less skillful operator can be used.

Setting the knives both as to vertical and horizontal clearance is also very important, and must be varied for different gauges and different types of material. In some materials the rotary knives are actually overlapped, and on the heavier materials do not quite meet each other.

Power requirements also vary depending upon the setting of the knives, but the prime consideration must be the quality of the cut edge.

NEW OPEN HEARTH FURNACES AT HOMESTEAD

By H. J. Pugsley
Engineer
Swindell Dressler Corporation
Pittsburgh, Pennsylvania

The latest addition to the Homestead plant of the Carnegie-Illinois Steel Corporation includes eleven 225 ton open hearth furnaces, together with the various auxiliaries required for their operation. These are located in what was one of the oldest residential sections of an old steel mill town, so that the operations of the complete Homestead plant, as a unit, may be carried out efficiently.

Hot matal is supplied the two 880 ton mixers from the Carrie blast furnaces. The ingots are processed in a battery of soaking pits, slabbing mill, re-heating furnaces, a 160 in. plate mill and shipping facilities, all of which are new.

The open hearth furnaces are built along lines which follow quite closely generally accepted practice for large furnaces. Slag pockets and checker chambers are large. Water cooling is incorporated in many points. Controls are installed with the idea that the operation of the furnaces should be automatic in as far as practical, but that the operators should be able to make any desired changes easily and operate the furnaces manually if desired.

Heavy oil is used as fuel, air is supplied the furnaces under pressure and large induced draft fans take the flue gases through waste heat boilers which supply the steam required for furnace operation, as well as considerable quantities to the rest of the mill.

The open hearth plant was designed to give plenty of working space on charging floor and in the other buildings such as stock house and mould conditioning buildings.

In this new open hearth plant, where the first heat was tapped June 14, 1943, has been made many thousands of tons of steel so badly needed in the war effort.

USE OF DEMULSIFIERS IN CIRCULATING OIL SYSTEMS

By T. G. Roehner and
E. S. Carmichael
Socony-Vacuum Oil Company
Brooklyn, New York

In the lubrication of steel mill equipment, water frequently contaminates the lubricant through faulty seals and gland leakages. To avoid immediate shutdowns of the mills for repairs, water is sometimes permitted to accumulate in the oils until the percentages rise considerably above 5 per cent. Sometimes the emulsion formed is quite unstable and may be easily resolved by the usual procedures employed at the mills. At other times, the resultant emulsion is highly stabilized and the water can be readily separated only by dehydration or by the use of demulsifiers.

Dependent on such variables as local preferences, available facilities and the stabilities of the emulsions involved, the methods which are employed for breaking steel mill circulation oil emulsions include one or more of the following:

1. Dehydration by blowing the oils at temperatures above 150 F or by heating the oils to temperatures over 212 F.
2. Settling at temperatures varying from room temperature to 175 F.
3. Centrifuging above 100 F.
4. Use of demulsifier.

This paper is concerned principally with the fourth method, i.e., the use of demulsifiers in combination with settling and centrifuging for breaking persistent emulsions. With this procedure, it has been found possible to accelerate greatly the demulsification of the water and in some cases it has been the means of avoiding shut downs of the mills. However, the problem is complicated by the requirement that the demulsifier be noncorrosive to the bearings, and also not function as an oxidation promoter to the oil. No attempt is made in the paper to discuss test methods for determining the suitability of a demulsifier in the latter respects, but a procedure is outlined for evaluating a demulsifier with regard to its efficiency in facilitating removal of water from a used, circulation oil.

Some of the basic concepts of emulsification are briefly reviewed. It is indicated that emulsions in steel mill circulation systems are almost invariably of the water-in-oil type. However, it is quite possible for multiple emulsions to be formed, if the proper emulsifiers are present and the emulsification conditions are favorable.

Data are presented which indicate the efficiency of certain types of demulsifiers for this application. It is shown, for example, that the incorporation of 0.5 per cent of a material, designated demulsifier A, facilitated complete separation of water from a used steel mill cir-

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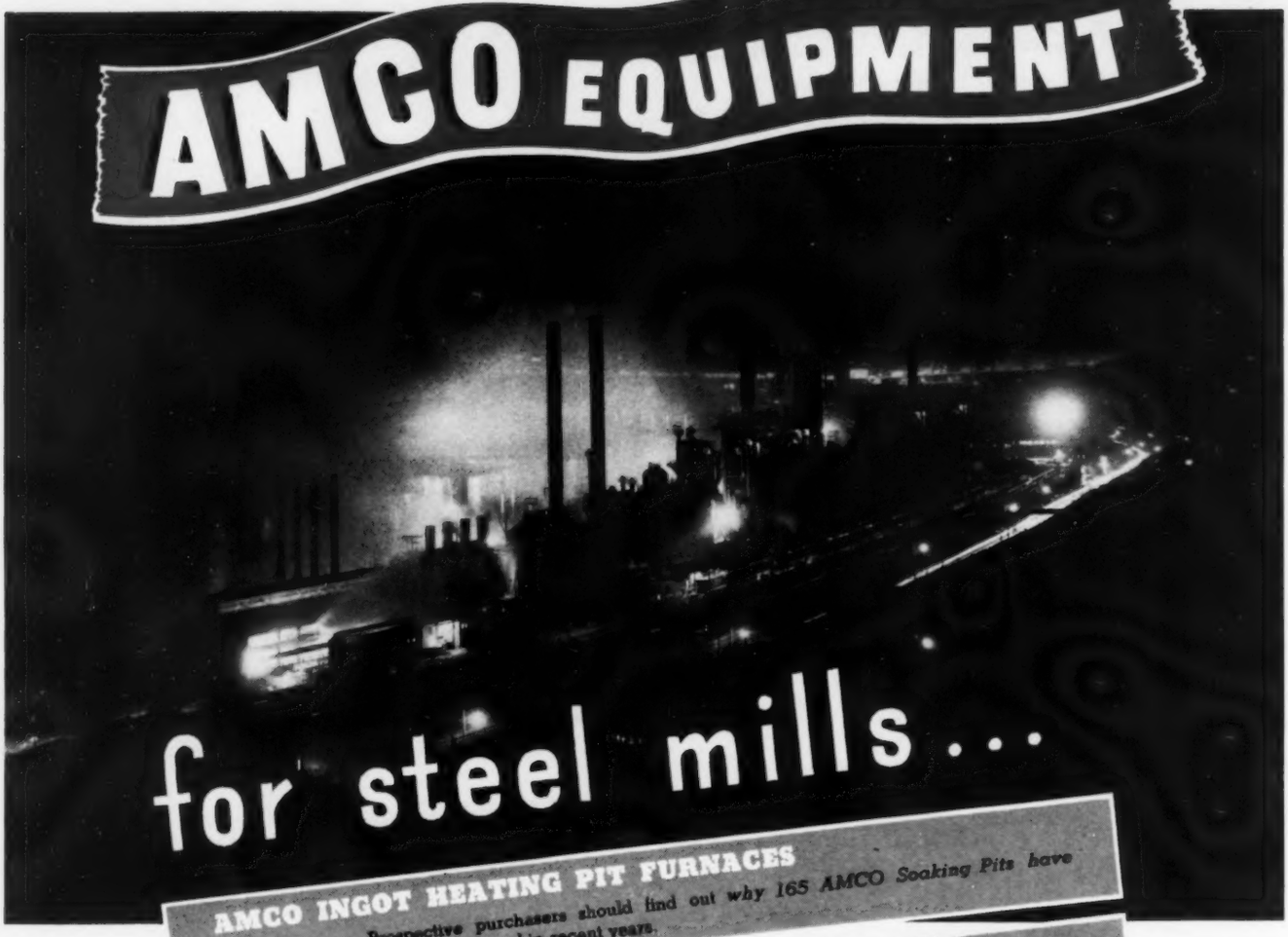

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culation oil, whereas, without the demulsifier present, practically no clear water could be readily removed. It is also shown that a material might be suitable as a demulsifier for a given oil and yet be ineffective in other cases.

ALLOY STEELS FOR MAINTENANCE IN THE STEEL PLANTS

By J. A. Rosa
Metallurgical Department
Republic Steel Corporation
Massillon, Ohio

Alloy steels owe their superior performance over carbon steels to the nickel, chromium, molybdenum and other elements which are added to give them qualities of greater toughness, deeper hardenability, higher ductility, greater abrasion resistance and better resistance to corrosion. Optimum development of these properties is usually dependent, however, upon a suitable heat treatment.

The benefits of alloy additions and proper heat treatment are most pronounced in large sections such as are encountered in plant maintenance work. The deeper hardenability of alloy steels insures greater uniformity of microstructure to the center of even the largest sections, which in turn assures higher tensile strengths.

The end quench hardenability test has made it possible to forecast the center hardness characteristics of a given steel in any diameter. Thus, using only the hardenability and strength data of a few steels it is possible to make a selection for a given application.

However, before a final choice is made, many other factors must be considered. Among them are:

1. The size of the section.
2. The strength requirements.
3. The wear characteristics.
4. The fatigue endurance necessary.
5. The response to the desired heat treatment.
6. The machinability desired.
7. The method of fabrication.
8. The corrosion resistance necessary.
9. Strength-weight ratio.
10. Present and future availability.

To these can be added cost and safety. Proper and profitable selection of steels requires that each of the foregoing factors be considered thoroughly before a final choice is made.

In the writer's plants the job of selecting and applying steels for maintenance work is handled by a three-man board representing the engineering, mechanical and metallurgical departments. This group checks each maintenance job for soundness of design, for method of fabrication and for the steel type currently used. The group's recommendations for maintenance and replacement have resulted in increased safety, lowered operating costs and better performance.

Although NE steels were developed as substitutes for the SAE grades, they are now considered as being alternates rather than substitutes. A list of the current NE types recommended as alternates for the SAE types is given in the paper.

THE UNITEMPER MILL

By M. D. Stone
Manager, Development Dept.
United Engineering and Foundry Company
Pittsburgh, Pennsylvania

The temper rolling of tin plate and sheet steel in sheet form is an old art.

Following the development of the strip mill, it became desirable to temper roll in coil form and gradually the old style 2-high plain bearing temper pass mills have been replaced by modern 4-high mills.

During recent years, the can manufacturers have required greater temper hardness of tin plate and at the same time require satisfactory ductility of the metal for fabrication, with the result that the temper pass mills have been built heavier and stronger to withstand rolling loads sometimes higher than those encountered in the cold reduction of the strip from the hot rolled gauge down to the required gauge before temper rolling.

Some years ago research and development were started on methods and means to produce this required harder plate with the thought in mind of producing a more ductile plate at the same time.

Out of this development has come a new type of mill and method of processing strip. Following laboratory and field experiments, it was decided that a unit should be built for continuing the experiments on a standard production scale. After discussion with some of the principal steel mills, the Republic Steel Corporation agreed to install such a unit in their Niles, Ohio, tin mill and to cooperate in carrying on the desired tests. This unit was placed in experimental operation approximately two years ago, but recently was placed in full production operation. Based upon the very excellent results obtained, it is now possible to introduce to the industry this new mill and process for tempering of cold reduced strip for tin plate, auto body sheets, furniture stock, stainless steel panels, etc.

SALVAGING FORGED ALLOY STEEL ROLLS

By H. L. Watson, Jr.
Superintendent, Special Products Dept.
The Midvale Company
Nicetown, Philadelphia,
Pennsylvania

The salvaging of forged alloy steel rolls is the problem of returning to useful service, rolls which are unserviceable. The decision to scrap or to reclaim a given roll can be made only after such factors as the over-all roll cost, the current status of the user's roll inventory, and the existing regulations governing the purchase of new rolls, have all been considered. A reduction in over-all roll cost per unit quantity of metal rolled, a roll inventory inadequate to maintain production schedules, or the impossibility of obtaining priorities for the pur-

chase of new rolls may dictate to the roll user that a definite roll salvaging program be inaugurated.

Although roll salvage, from a broad standpoint, includes such operations as simple regrinding and the removal of shallow surface spalls, it is usually understood to consist only of those operations which cannot generally be done in the roll user's own shops. Such salvaging operations can consist of any one of the following: (a) reconditioning and rehardening for additional use in the same rolling mill or for use in a smaller mill; (b) the shrinking of forged, heat treated, or hardened steel sleeves on worn or turned down cast or forged backing-up rolls.

To economically salvage rolls, it is advisable for the roll user to increase the tolerances on certain portions of the roll to prevent the reclamation cost from becoming excessive. This applies in particular to those rolls which are to be reconditioned for further use in the same mill and which would have to have certain portions restored to original blue-print dimensions if their tolerances could not be increased. In certain cases, these original sizes must be maintained, but in other instances, rolls have been successfully used with considerably greater clearances than were at first thought possible. To keep the cost of converting a given roll into a smaller size to a minimum, the difference between the two should not be too great.

The sleeving of worn out backing-up rolls is an engineering problem in which certain factors such as the size of the roll, its hardness, the wall thickness of the sleeve, the shrink-fit allowance, and the method of locking the sleeve to the mandrel, must all be most carefully weighed. Intelligent consideration of all of these factors will usually result in a built-up backing-up roll which will give excellent performance.

Depending upon conditions, it may be possible to reduce operating costs by adopting a program of roll salvage.

CURRENT DEVELOPMENTS IN INDUSTRIAL LUBRICANTS AND THEIR INFLUENCE ON POST-WAR PRODUCTS

By G. F. Bowers
Standard Oil Company of Indiana
Chicago, Illinois

The demands in the war effort have influenced lubricants along two important basic lines. First, the use of the necessary lubricants to keep in operation, as nearly continuously as possible, the equipment already in service even though greater demands were made on this equipment. Second, the development of new or improved lubricants to meet the wide range of severe conditions encountered, particularly by the armed forces, in new equipment and new uses of equipment.

There have been improvements in most petroleum products but the greatest improvement has been in greases. While this may have been due in part to the fact that the quality level of greases was somewhat lower than other products, it was primarily due to the absolute necessity of having available greases that could be used through wider ranges of operation.

Gear lubrication has been and still is one of the most difficult problems encountered in industry. With the continued trend to transmit more power through smaller units the demands on the lubricant become more severe. The current effort is to supply more stable products which will carry the added loads.

Additives are of major importance and are carefully considered in practically all development work. Without them it would not be possible to do many of the things being done today. These products are added for detergency, for low cold test, to minimize oxidation, corrosion, etc. Motor oils, diesel engine oils and many special products give improved performance because these special products permit building products with particular characteristics.

Synthetic oils, so called because the finished product is the result of controlled chemical reactions, will play an increasingly important role in special lubricants, or for special application.

There has always been the need for rust preventives but the need of saving equipment during this time it cannot be replaced has stimulated their use. They will continue as an important phase of the work of the lubrication engineer.

BLAST FURNACE GAS — WET WASHED OR DRY CLEANED?

By Frank X. Gilg
Service Department
The Babcock and Wilcox Company
New York, New York

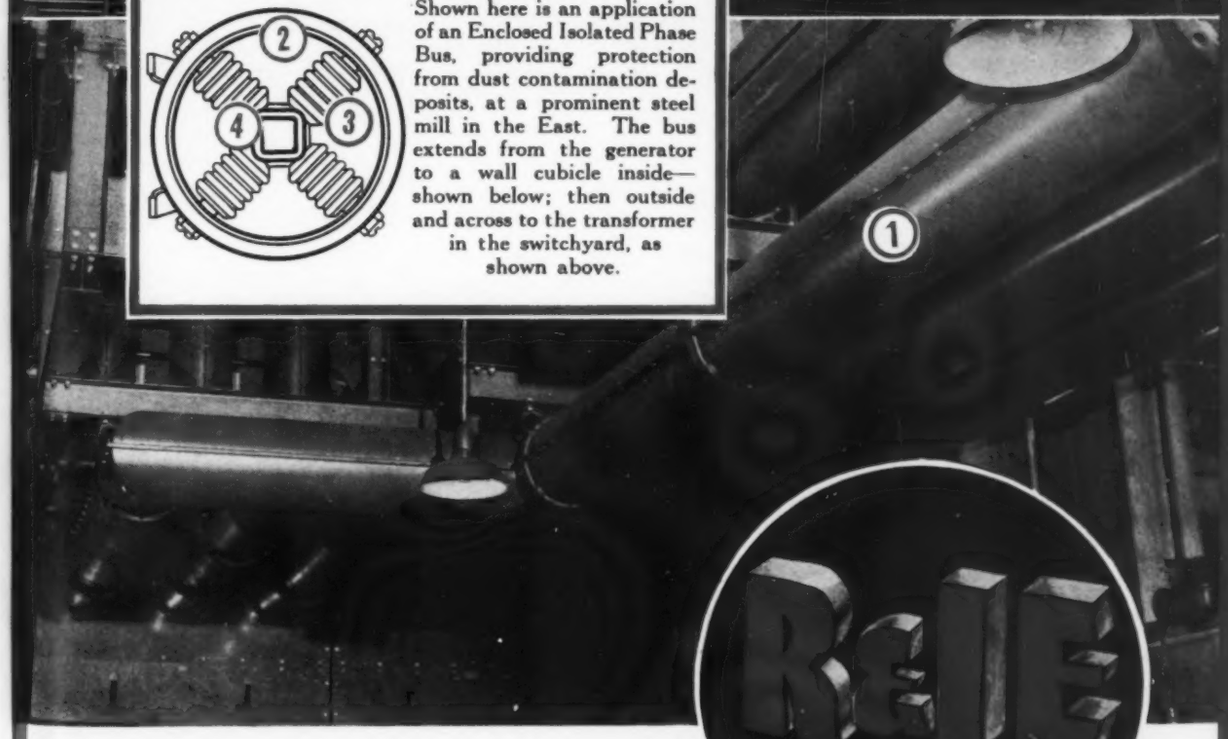
Blast furnace gas is inherently a dirt laden fuel, the dust loading depending upon the gas cleaning process being used. When boilers are operated with blast furnace gas alone without supplementary pulverized coal or coke breeze, the heat absorbing surfaces become fouled with deposits which reduce the heat absorbing capacity and lowers the efficiency of the unit. The exit gas temperature leaving the unit rises to a point where it becomes necessary or advisable to take the unit out of service for external cleaning. Except for the time element, it makes very little difference whether the blast furnace gas dust loading is 5 grains or .05 grains per cubic foot of gas; there will be deposits on the tubes. The nature of the deposits however may be quite different and some will be very difficult to remove with soot blowers. The author has obtained some data from four plants using different methods of blast furnace gas cleaning, showing the effect of dust deposits on the heating surfaces, the effectiveness of soot blowers and hand lancing in removing these deposits, the effect of supplementary pulverized coal firing, ash analysis of deposits from wet and dry cleaned blast furnace gas and some thoughts as why one is more difficult to remove than another and some other conclusions.

(*Please turn to page 134*)

CHECK the FACTS

1. Sealed, dust proof, individual bus housing provides phase isolation and prevents interphase short circuit. Removable covers in unit sections simplify routine inspection.
2. Supporting ring frames equalize all stresses. Can be mounted in any position.
3. With interchangeable insulator units always in compression, porcelain is used to its best advantage.
4. The same conductor support collar is used for both fixed and expansion slide position. Conductor can be square, round, channel or bar, insulated or bare.

Shown here is an application of an Enclosed Isolated Phase Bus, providing protection from dust contamination deposits, at a prominent steel mill in the East. The bus extends from the generator to a wall cubicle inside—shown below; then outside and across to the transformer in the switchyard, as shown above.



The Check List

- CONDUCTOR SUPPORTS, CLAMPS AND FITTINGS
- DISCONNECTING SWITCHES INDOOR AND OUTDOOR
- AIR BREAK SWITCHES
- INTERRUPTER SWITCHES
- CUTOUTS AND THERMO-RUPTERS
- SWITCH OPERATING MECHANISMS
- SUBSTATIONS
- OPEN OR ENCLOSED, ISOLATED PHASE HEAVY DUTY BUSES
- KIRK INTERLOCK SYSTEMS
- AUTOMATIC SECTIONALIZING EQUIPMENT
- METAL CUBICLES
- TESTING DEVICES

R&IE

ISOLATED PHASE BUS

RAILWAY AND INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.

IN CANADA—EASTERN POWER DEVICES, LIMITED, TORONTO

ADDITIVES IN OIL FOR THE STEEL PLANT

By C. E. Pritchard
Lubrication Engineer
Republic Steel Corporation
Cleveland, Ohio

Modern design of steel mill equipment incorporating higher speeds, increased bearing loads, greater gear tooth pressures, and wider operating temperature ranges coupled with the ever present request for increased production from our older units presents a major problem to both the lubrication engineer and the lubricant supplier. Quite often, in order to meet these conditions, it has been necessary to augment the natural qualities of the conventionally refined petroleum oils with additives.

The use of inhibitors in modern turbine oils has undoubtedly been one of the most important developments offered to the steel plant operator in recent years. Coming at a time when maximum service of turbine equipment was deemed mandatory to meet increased steel production demands, the added improvements including oxidation resistance, freedom from corrosion, excellent water repellence characteristics, and increased service life have minimized the costly delays during shut down periods as formerly experienced.

Anti-oxidants — A single molecule of an anti-oxidant can prevent the reaction of thousands of hydrocarbon molecules. Thus, anti-oxidants in very low concentrations of the order of 0.001-0.1 per cent can prolong the life of an oil several fold. The gross effect of oxidation inhibitors is to maintain the rate of oxidation at a relatively low level for an interval known as the induction period, or until the concentration of anti-oxidant is depleted.

Anti-corrosive agents — Under this general heading are classed both materials to prevent corrosion of metal by constituents developed by oxidative deterioration of the oil or those materials designed for protection of metal surfaces from atmospheric corrosion. The first being controlled by the addition of an agent to form an impervious coating on the metal preventing direct contact of the corrosive agents with the metal. The second being prevented by addition of compounds with a polar grouping.

Anti-catalysts — The control of catalytic reaction is made possible by the use of metal passivators or metal deactivators.

Extreme pressure lubricants both in the fluid and plastic state have been universally accepted by the machinery builder and lubrication engineer to protect both gears and bearings under extreme loading conditions. Pressures of from five to seven times greater than would be possible to carry with a conventional lubricant are satisfactorily met by usage of an extreme pressure lubricant.

Anti-wear agents — Substances which form, probably by chemical reaction, films on the metal surfaces are employed as anti-wear agents. Phosphorus and arsenic containing materials are commonly used, tricresyl phosphate being a representative type.

Anti-friction agents — Fatty acids derived from natural animal and vegetable fats are most commonly used as anti-friction additives due to their polar grouping and better wetting properties.

Extensive research in the metallurgy and lubrication of the high speed diesel and gasoline engines has offered an efficient and economical motive power unit to the steel industry, especially for railroad switching service, locomotive cranes, etc.

Detergents — Metallo-organic compounds are used to peptize or float the insoluble products into the oil itself thereby preventing its deposition on the metal surface.

Viscosity index improvers — Better sealing results from the higher viscosity indices affected by the addition of a viscosity index improver.

Pour point depressor — Low temperature starting conditions are satisfactorily met with oils containing a pour point depressor without the drastic dewaxing procedure demanded formerly.

Cutting fluids for the steel industry are generally classified on a basis of their service requirements.

Light duty —
1. Straight mineral oil.
2. Soluble oil.

Medium duty —
1. Mineral lard oil.
2. Lard oil (undiluted).

Heavy duty —
1. Sulphurized mineral oil.
2. Sulphurized mineral lard oil.
3. Soluble (heavy duty type).

GAS TURBINES FOR BLAST FURNACE BLOWERS

By Paul R. Sidler
Electrical Engineer
Brown, Boveri and Company, Ltd.
New York, New York

Application of supercharging principles successfully used in increasing diesel engine capacity, Velox boilers and Houdry regenerators to the problems of blast-air compression and preheating produces compact units for steel mills at substantial savings in cost and space compared to existing procedures.

Blast air is tapped from an axial compressor at any suitable stage. Constant volume at varying pressure is obtained by speed regulation combined with blow-off through the same governing devices as for centrifugal blowers.

Power for compression comes from a gas-turbine unit consisting of three essential elements, that is, an axial compressor capable of delivering large volumes of air at about 60 psi gauge, a combustion chamber in which oil or gas fuel is burned with relatively large amounts of excess air and a gas turbine which expands the hot combustion gas to atmospheric pressure. Expansion of products of combustion in the gas turbine provides not only sufficient output to drive the air compressor but a sizeable surplus which could be used to

drive a generator in stationary, locomotive, marine or airplane application, but which can equally well be taken out in the form of compressed air for blast-furnace use.

Gas turbines, now recognized as practical prime movers, have been studied in many quarters since the beginning of the century, but early types were uniformly unsuccessful due to lack of an efficient air compressor. One of these experiments in France in 1906 was the immediate cause for the manufacture of the world's first centrifugal compressor. This machine soon found interesting applications, among them that of blast furnace blowing.

While other firms developed water-cooled designs, our company concentrated on air-cooled blowers and introduced the first blast-furnace set of this type in the United States in 1926. Their research on gas-turbine problems advanced through the exhaust-gas turbo-supercharger for 4-cycle diesel engines in 1924, the Velox steam generator with gas-turbine driven air compressor in 1930, the high-efficiency axial-flow compressor in 1932 and the larger units for regeneration in the Houdry oil-cracking process in 1936 to the first independent gas-turbine power unit in 1939.

Even with the present limitation in gas inlet temperature at around 1120 F, the thermal efficiency for blast-furnace plants (and certain other applications) compares most favorably with that of other prime movers. The gas turbine has also advantages in the absence of water, simplicity, low cost and small space requirements.

By combining a gas turbine driven blast-furnace blower with a steel tube blast heater designed along Velox boiler principles — that is, applying a pressure of 30 pounds or even higher and using the same combustion chamber — the entire blast generating plant requires only a fraction of the space needed in customary lay-outs. The cost of such installations is also substantially lower, while the thermal efficiency is greatly increased.

Detailed comparisons of heat consumption and other factors support the conclusion that gas-turbine driven blast-furnace blowers with or without supercharged blast heaters show many advantages over present methods and equipment and therefore deserve serious consideration for replacements as well as extensions of existing furnace plants.

AN IMPROVED SYSTEM OF ELECTRIC DRIVE FOR CRANES

By M. A. Whiting and
J. A. Jackson
Industrial Engineering Division
General Electric Company
Schenectady, New York

An electric drive named the Maxspeed system has been developed for the hoist motion of cranes and has demonstrated its fitness by earning its living away from home. This system is applicable for operation from either d-c or a-c incoming power.

The characteristics of this system are very different in several respects from those of any crane hoist system in general use. The most radical departure is the characteristic when lowering with the controller wide open. Under this condition the speed is high when sending down the empty hook, but is inherently less when lowering loads, the heavier the load on the hook the slower the lowering speed.

The system is described briefly, characteristic curves are shown and a practical installation is illustrated.

CLEANING OF STEEL FOR SUBSEQUENT COATING

By Nelson E. Cook
General Superintendent of Galvanizing Operations
Wheeling Steel Corporation
Wheeling, West Virginia

From the standpoint of the coating operator, the cleaning and preparation of the base sheet is probably the most important, yet most neglected, step in the total process of making coated products.

The coating operator needs clean sheets in order to produce continuous, uniform, adhesive coatings, at the same time making the most efficient and economical use of the coating material.

The coating operator is yet unable to determine the degree of cleaning necessary for different processes because there is no definite yardstick for measuring cleanliness.

Slow progress seems to have been made in solving this problem, possibly due to a lack of mutual understanding of the problem by the producers of sheets, cleaning technicians, and coating operators. In order to arrive at a solution, there should be coordinated study with a view to simplifying and standardizing cleaning processes.

CLEANING STEEL FOR SUBSEQUENT COATING

By J. J. Duffy, Jr.
Development and Service Engineer
Pennsylvania Salt Manufacturing Company
Philadelphia, Pennsylvania

The steel industry's post war objectives are: 1. increased rate of production; 2. lower costs; 3. better quality; and 4. improved appearance.

Cleaning is one of the most significant operations in obtaining all of these objectives. The choice of proper chemicals for the cleaning bath is just as important as the selection of equipment and the technique of applying the various finishes.

Three major forces by which soil can be removed from steel surfaces are chemical, physical, and mechanical.

Specific examples of each of the foregoing classes are:

Chemical means — Saponification, neutralization and other chemical combinations such as pickling.

Physical means — Emulsification, solubilization.

Mechanical means — Agitation (electrolysis) and abrasion (brushing, sand blasting, etc.).

There is one obvious shortcoming of an alkali when properties of this kind are reviewed — i.e., an alkaline cleaner has very little solubilizing power. It functions principally through emulsification, saponification and agitation.

Recent studies directed toward incorporating in the cleaning process more of the solvent properties outlined previously under "physical means," have shown some rather encouraging results. Outstanding among these is the use of the solvent emulsion type cleaner.

Many revisions in the lubricants have been made as a result of the shortage of critical materials; these changes have magnified the job required by the cleaner.

A substantial number of these compounds stubbornly resist normal alkaline cleaning and, frequently, a solvent type or an acid type pre-treatment is desirable in order that the alkali may exert its maximum cleaning power.

Solvent emulsions are gradually being recognized as definite aids to the cleaning processes of many metal finishing industries. The solvent emulsion cleaner, of course, is always used in conjunction with standard alkaline cleaning. Its application does not represent a radical departure from established cleaning procedures — straight alkaline cleaning is still the final cleaning.

Water is the one raw material used in the cleaning process over which we have little control. I cannot stress too deeply the importance of choosing the chemicals for cleaning with a definite eye to type of water available. Variations in the water supply might very well have an immediate and direct bearing on important phases of the cleaning operation.

Some degree of controversy exists in the steel industry on the subject of various methods of electrolytic cleaning together with its contrast to soak (or non-electrolytic) cleaning. The important fact to remember here seems to be that agitation is necessary. Our experience has been in favor of the use of electrolytic cleaning, in spite of some installations where successful cleaning is done without its aid.

No one chemical or chemical cleaning process represents a panacea. The specific conditions existent at the mill under consideration must be thoroughly studied and the chemicals applied to cleaning chosen accordingly. Until the day when some research chemist develops a universal product, all of us must continue to give serious consideration to the cleaning operation.

ELECTROLYTIC CLEANING LINES

By Joseph I. Greenberger
Development Engineer
United Engineering and Foundry Company
Pittsburgh, Pennsylvania

Successful coating of strip requires proper cleaning at the proper stages. It has been established that unless the rolling oils and foreign matter are carefully removed from the strip prior to annealing, subsequent coated plate will be spotty and of inferior quality. The electroplating industry has long known the necessity of chemically clean stock as a prime requisite for successful plating and the recent advent of electrolytic tinning and electrolytic galvanizing lines in the steel industry has made it necessary for the steel mills to re-examine their practice in the light of the electro-plating industries' experience.

Development of continuous tandem cold rolling and reversing mills created a specific cleaning problem. It was found that the high pressures of cold rolling forced the rolling oils into the pores of the strip which when added to the normal amount of mill "pick up" of foreign matter created undesirable operating features. During subsequent annealing, the rolling oils would carbonize, resulting in badly stained strip. The closely adherent grit and foreign matter would mark the work rolls of the skin pass mills, resulting in a characteristic series of find marks familiarly known as "cat's paws," "mice tracks," etc., making frequent roll changes necessary to get proper strip surfaces. The adherent foreign matter resulted in porous tin plate and excessive menders and strippers. Development of the electrolytic cleaning process as an intermediate stage between the cold rolling and the bright annealing corrected these undesirable features.

The slow speed of various "still" solvent and emulsion type cleaners as well as their inability to remove closely adhering foreign particles from the strip surfaces eliminated these processes as possibilities for tin plate cleaning.

As a first cleaning process, there was developed a caustic dip line combining chemical and mechanical cleaning and consisting essentially of a caustic dip tank, scrubber, and rinses. These lines were limited to speeds up to about 300 feet per minute and the quality of cleaning was apparently satisfactory. As mill speeds and tonnage increased, and as tin house specifications became more rigid, development took place of high speed electrolytic cleaning lines combining electrolytic, chemical, mechanical, and thermal actions.

The electrolytic cleaning cycle, as developed for strip applications, consists of four distinct phases:

1. Primary excess oil and dirt removal to take off the bulk of the surface oil and foreign matter.
2. Electrolytic cleaning to remove the oil and foreign matter from the pores of the metal.
3. Scrubbing and rinsing to remove "carried over" loose surface scum.
4. Drying of the strip.

Coordination of suitable mechanical and cleaning equipment to successfully feed the strip through the proper cleaning cycle with a minimum of handling and down time was a gradual growth until the present time, and now electrolytic cleaning line speeds of 2000 feet per minute and over are accepted practice.

Tin plate electrolytic cleaning lines have been designed to handle centerless coils 16½-20 in. inside diameter and 48-66 in. outside diameter in widths from 16 inches to 38 inches, and in gauges from No. 16 to No. 38. Coil weights range from 6000 pounds to 30,000 pounds. Line speeds are a function of the required production.

(*Please turn to page 138*)

Spare the Rod and Spoil the . . . Rope

Proper twist, bend, elongation and tensile strength in wire rope are *inherent* qualities —in which the wire rod mill plays an important part.

Production—and profits—are measured in uniform, trouble-free tonnage, such as you can produce on Morgan Rod Rolling Mills.

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Electrolytic cleaning lines have also been developed for wider and heavier plate covering the sheet mill range. Aluminum and other non-ferrous cleaning lines are also available.

Experience on the various electro tinning and electro galvanizing lines indicates that the best possible cleaning following the cold reduction is necessary to insure properly prepared base plate. There is sufficient handling after the annealing operation in the temper rolling and possibly side trimming operations to conceivably permit pick up of foreign matter before the final coating, so an electrolytic cleaning cycle in the electro tinning and electro galvanizing lines is recommended. Judging from the excellent results, we might conclude "Cleanliness pays."

A MODERN STRIP PICKLING PLANT

By Lane Johnson, Jr.
Development Engineer
United Engineering and Foundry Company
Pittsburgh, Pennsylvania

The semi-continuous type strip pickler was originally developed with the special requirements of certain members of the industry in mind and has, after several years of successful operation in the several plants in which installations have been made, proved so satisfactory that a prominent place in post-war pickling planning is predicted for it.

The conventional continuous type strip pickler involves joining of successive coils in order to provide continuity; it requires looping pits to permit storage capacity so that time required to join without slowdown in the processing zone is provided; and it must include shearing facilities for parting after pickling so that individual coils can be delivered for future rolling or other processing.

The semi-continuous type, on the other hand, takes advantage of the inherent stiffness of flattened hot rolled strip and each coil is processed individually by pushing through the various tanks, pinch rolls, etc., thus eliminating the need for joining equipment, looping pits and shearing facilities, and resulting in substantial savings in investment and space required.

A hot rolled coil, the corners of the leading end of which have been clipped to facilitate guiding, is placed in a coil box and the leading end fed into the bite of quick-opening pinch rolls. The pinch rolls feed into a roller leveler, which properly flattens the strip and acts as the main push unit to feed it into a preheat hot water tank, which elevates the strip temperature to pickling level, and then into a synchronized pinch roll, which in turn feeds into the first acid tank. Successive pinch rolls feed into as many acid tanks as are required to meet the production. With pickling completed, the strip is rinsed first in a cold power spray, then into a hot dip tank. After passing through a hot air dryer, it is then recoiled in a 3-roll upcoiler, and when kicked out, is ready for further processing.

Combination fume duct and sewer serves all hot tanks for removal of fumes and all tanks as main sewer line. All acid tanks are provided with a specially contoured bottom lining so that the strip is supported on its edges, thus permitting the bottom to be pickled as equally and effectively as the top. New acid is continually presented to the strip by means of pump circulation systems. Temperature is automatically controlled and unusual attention paid to reducing heat losses to a minimum.

In short, every effort has been devoted toward evolving a pickling plant to meet the demand for an installation involving lowered investment cost, to meet production requirements in spite of a lowered available manpower potential, to permit operation in a satisfactory and effective manner, and to attain cumulatively an appreciable reduction of overall operating costs. Experience and satisfaction accruing from existing installations seem to testify to the accomplishment of these goals.

MAINTENANCE WITH "LOW TEMPERATURE" WELDING

By R. D. Wasserman
President
Eutectic Welding Alloys, Inc.
New York, New York

"Low temperature" welding is a new welding process with features that make it particularly suitable for maintenance work of all kinds on all metals. "Low temperature" welding rods may be applied by procedures similar to brazing or soldering and fusion welding.

Soft soldering is accomplished at temperatures below 750 F, and employs alloys predominantly of lead and tin, which simply adhere to the surface of the parent metal. For brazing and bronze welding, copper or silver-copper alloys are used at temperatures above 1150 F, and the bond between the brazing alloys is simply the adherence of the alloy to the properly prepared surface of the base metal. Because of the relatively low strength of brazing alloys, the clearance of the joints in which they are used is quite important and should not exceed .003 in. if maximum strength is to be obtained.

"Low temperature" welding is generally performed in the temperature range of 340-1800 F. As mentioned before, the procedures for "low temperature" welding are similar to those with which all welders are familiar, but the bond between the weld metal and the base metal is accomplished by surface alloying of the molten weld metal with the still solid base metal. This surface alloying is caused by the formation of the eutectic alloy of the metals present in the welding rod and the base metal. The weld metal having a great affinity for the base metal actually dissolves or combines with the surface of the solid base metal at base metal temperatures which may be as much as 800 F below its melting point.

Because of their low temperature of application, and the unequalled high strength obtained, they are particularly suited to maintenance and repair work where

the applications of high temperatures cause distortion and damage to the base metal. There are "low temperature" welding alloys for use on every metal from zinc-base die castings to hard-surfacing alloys.

THE PLACE AND EFFECT OF CONVEYOR EQUIPMENT IN INDUSTRY

By J. E. McBride
Vice President
Palmer-Bee Company
Detroit, Michigan

Conveyor equipment contributes largely to reduce luxuries to necessities, to conserve human effort, to relieve fatigue and to increase general well-being and prosperity.

Our history is full of examples of important developments in mechanization which were at first feared because they would apparently release men from employment. Instead, these labor-saving devices have been dominating factors in the development of the United States.

Conveyor equipment in industry brings advantages to the employer as well as the employee. Following the present war, the pent up demand for labor saving devices of all types will tax our productive capacity.

The steel industry is already highly mechanized, but as its products are expanded in new and varied postwar uses, new types of material handling equipment will be needed. Some of these may come from industries into which go the products of the steel industry. Two types of these are the overhead trolley conveyor and the floor type carry-all.

A number of improvements have been made on material handling equipment already in use in the steel industry. Roller conveyors have been redesigned so as to withstand better the heavy loads and shocks. Hot coil conveyors have developed through various stages of design to provide strength, durability, long travel, smoothness of running, etc.

Material handling equipment, by saving inestimable man-hours, has contributed greatly to our production victory.

HAND WRITTEN COMMUNICATIONS

By Whitney Hayes
Branch Manager
TelAutograph Corporation
Pittsburgh, Pennsylvania

TelAutograph service consists of furnishing equipment to send communications from one point to one or more other points, instantaneously, and in the original handwriting.

It is used to quite some extent in the iron and steel industry, where immediate and accurate transmission of chemical analyses, pit charging schedules, and rolling information is so important.

By means of TelAutograph service, analyses can be transmitted instantaneously from the chemical laboratory to blast furnaces and mixers, or to openhearths, bessemer converters, soaking pits, blooming mills, production planning departments, mill recorders, etc., in one writing. The production planning department can instantaneously notify all interested departments, if the heat is off standard, and re-apply the heat. The blooming mill can notify the billet mill, bar mill, and shears of the sizes to be rolled. In other words, this service will expedite the control of each ingot of every heat as it passes through the various processes. It will act as the working tool to prevent "mixing" of heats.

TelAutograph service is also applied to transportation procedures. In this application, certain points in the mill, where "switch order" activity is heavy, are equipped with transceivers, which are connected to receiving stations, either in a yard office, or in a transportation coordination office. Thus, the switch orders from these points are transmitted in writing, accurately and efficiently, and the control achieved tends to decrease demurrage, engineering hours, and man hours.

COMMUNICATION IN INDUSTRIAL PLANTS

By F. C. Millard
Public Address Engineer
Agent for Western Electric Equipment
Distributed by Graybar Electric Company

The article deals with the early history of modified public address systems applied to industrial plants for communication purposes under severe noise conditions. It is pointed out that a lot of unfortunate experiences occurred in the development of this art due to lack of properly designed apparatus being available.

About 1939, equipment that was mechanically and electrically suited to application in this field became available and the process of introducing the idea to steel plants began.

It was not difficult to find engineers who agreed that the idea was a good one, but they were, at the same time, skeptical as to the possibilities of making it work, simply because it had been tried with one form of equipment or another and had not proved successful. The reasons for such failures are outlined in the article, and a review of the progress in development of various installations is made.

Typical installations are described but no attempt is made to cover all the various types of installations that have been made. A description of applications under the following conditions is presented:

Rolling mills, continuous mills, bessemer converters, blast furnaces, soaking pit buildings, supervision, crane systems, coal tipples, etc.

A discussion of the requirements of a plant-wide paging system is included in the subject matter of the article.

Brief descriptions of unique installations are included, and a general discussion of the types of equipment that should be used in this work points out that the type of loud speaker selected for use in any given location is important; a loud speaker used on an office installation will not do the job in a mill location; likewise a loud speaker that will serve the purpose in a roller's pulpit may not necessarily be suited for use out on the mill floor.

A paragraph is devoted to system planning, pointing out that a well planned and properly designed system may be installed with a minimum of labor and material, and expanded as conditions may require to several times its original size without discarding any of the original installation.

Under the subject of post-war possibilities, it is pointed out that high-level communication systems are not a war time development, and that they have a definite place in post-war activity because of their economic value.

THE ELECTRONIC FREQUENCY CHANGER

By A. G. Darling and L. W. Morton
General Electric Company
Schenectady, New York
and
F. W. Cramer
Carnegie-Illinois Steel Corporation
Pittsburgh, Pennsylvania

The installation of the first 20,000 kw electronic power converter was made in December 1943 at the Edgar Thompson Plant of the Carnegie-Illinois Steel Corporation to exchange power between their 25 cycle, 44 kv and 60 cycle, 69 kv systems, the latter being connected to a large public utility. The converter operates in parallel, on both systems, with normal generators. This type of converter was selected to obtain its ease and simplicity of control, low contributions to faults, light weight of indoor equipment, high efficiency, and ability to transfer a fixed value of power regardless of departure from normal frequency ratio between the two systems. The converter may have its power output controlled manually or by a power regulator or may reduce the demands for power taken from the 60 cycle utility system. Controls may also be supplied to a typical electronic converter to cause it to share the total load of the receiving system in a predetermined proportion with prime movers. Inherently transfering power in a preselected direction in relation to the departure from normal voltage ratios of the two systems, automatic phase control of grid excitation rapidly compensates for changes in this ratio. The reactive kva, needed for commutation, harmonics and transformer magnetizing current of both rectifier and inverter, is supplied by the synchronous machinery in the steel company's systems.

Faults, such as arc-backs and shoot-throughs in the electronic equipment, are suppressed in a very short time. The rectifier cannot furnish current to a fault in its supply system. The inverter can supply only a small increase over load current to a fault in the receiving system. When the fault in the receiving system depresses its voltage below commutating limits, the inverter instantly ceases to commutate and consequently furnishes no current to the fault. After release of the fault from the receiving system, the converter will pick up load in a maximum of 4/10ths second.

The authors conclude that the electronic converter is suitable for controlling power flow between systems of like or dissimilar frequency and voltage or to furnish power to isolated loads which have sufficient synchronous capacity for commutation, etc., at fixed or variable frequencies. As required, the d-c link between rectifier and inverter may be lengthened to the classification of a transmission system. Interconnection of systems may be accomplished in a number of different ways, each having certain characteristics. The electronic converter may prove advantageous in some instances; rotating converters may be more advantageous in other instances.

DISPOSITION OF COKE OVEN AND BLAST FURNACE GAS OVER WEEK ENDS

By Harold C. Cox
Superintendent, Steam and Combustion Department
Bethlehem Steel Company
Johnstown, Pennsylvania

During these times the full benefit of coke oven and blast furnace gas must be obtained in the steel plant, not only for reasons of economy but to further the war program and conserve our country's natural resources.

This discussion has to do with the displacing of oil and coal by coke oven and blast furnace gas in the steel plant, thereby relieving at least some of the difficulties of transporting and maintaining supplies of oil and coal.

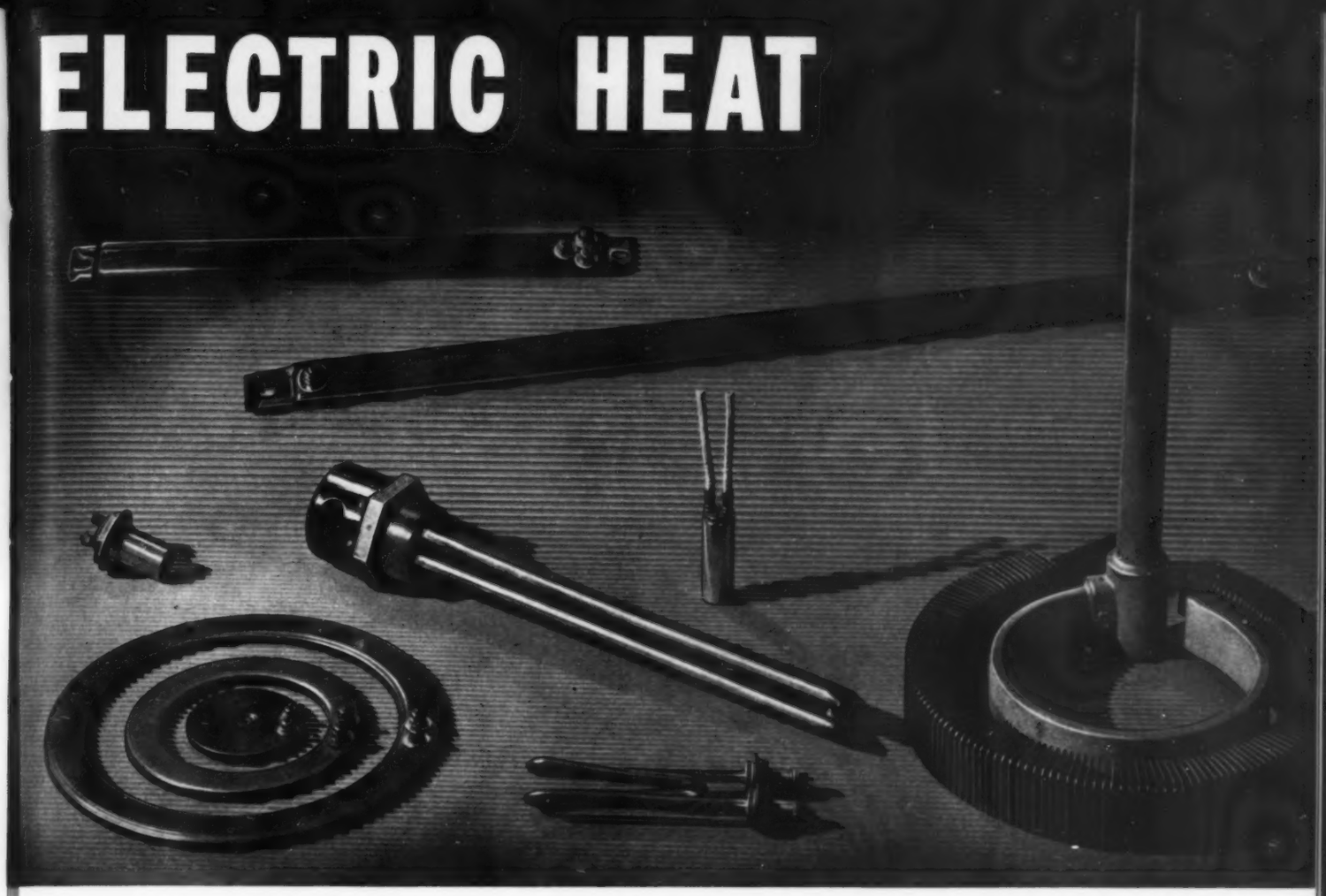
Regulating the supply of coke oven gas to open hearth furnaces by pressure controlled signals will be related and the part dispatchers play in the handling of coke oven and blast furnace gases to various mill furnaces and boilers will be described.

A schedule of coke oven gas demand and supply will illustrate the problems that arise in handling the gas from day to day and over week-ends. The gas supply and the demand are balanced so that wastage is kept to a minimum without the use of gas holders.

By regulation and control of coke oven and blast furnace gas, it will be shown how the loss has been kept to 1 per cent for coke oven and 17 per cent for blast furnace gas in the Johnstown plant.

(*Please turn to page 142*)

ELECTRIC HEAT



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THE CONTINUOUS DETERMINATION OF OXYGEN AND COMBUSTIBLES IN FURNACE FLUE GASES

By John F. Luhrs

Research Department

Bailey Meter Company

Cleveland, Ohio

Every one interested in combustion recognizes the importance of proper regulation of fuel and air to fuel economy, and such factors as furnace temperature and maintenance. This paper discusses the use of the oxygen and combustibles content in furnace gases as a combustion guide and as an aid in establishing the performance of fuel burning equipment, the amount of air infiltration and the stratification of flue gases. Curves are presented illustrating the relationship between oxygen content and excess air and the fact that such relationship is substantially the same regardless of the fuel or combination of fuels being used. The effect of a large percentage of inerts in fuels on such relationship is recognized.

The problem of continuously sampling gases from open hearths and other types of furnaces is considered, and a water-cooled, water-washed sampler, which has proved satisfactory for drawing a continuous sample directly from various types of furnaces, is illustrated and described. Chart records made by continuous oxygen recorders on various types of furnaces are analyzed.

BLAST FURNACE SKIP HOISTS

By Gordon Fox

Vice President

Freyn Engineering Company

Chicago, Illinois

The paper deals with some aspects of the employment of variable voltage for blast furnace skip hoist drives. Discussion is confined to the two-motor drive in view of its current predominence.

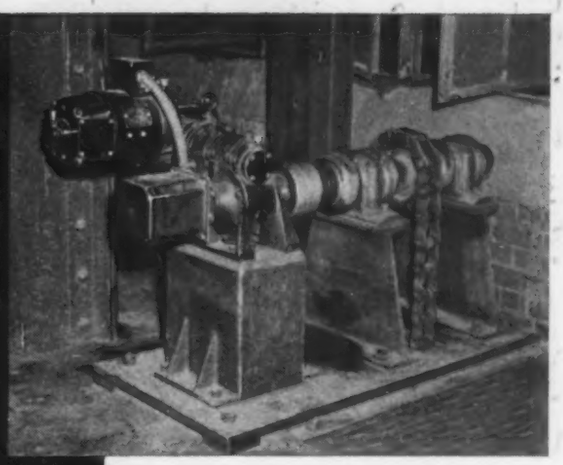
The torque requirement of blast furnace skip hoists is great at the start of the cycle and much less when full running speeds are attained. In view of this fact, the use of shunt-field control, for about half the speed range, offers important advantages.

A combination has been developed, and successfully applied, in which the lower portion of the speed range is obtained through voltage variation, and the upper portion of the speed range is obtained by controlling the shunt field strength of the hoist motors. The use of stabilized motors is essential and considerable departure from conventional methods is involved.

The two motors driving the hoist may be connected in series or in parallel. The latter arrangement enjoys advantages.

A novel arrangement has been installed at a group of three new blast furnaces at a western plant in which a single, three-unit motor generator set is employed at each blast furnace to supply variable voltage for the skip hoist motors and also to supply constant potential for the other direct current motors about the furnace. Continuity of operation is fully insured without the use of any idle reserve equipment.

A weakness of variable voltage control rests in the dependence upon the integrity of the additional links represented by the motor-generator set, exciters, etc. A combination control has been evolved which normally employs variable voltage for the lower portion of the speed range but in which series-parallel connection of the hoist motors, fed from the constant voltage system, may be substituted in case of necessity. Independence from the motor-generator set and all of its accessories, as well as the a-c supply system and its switching, is thus readily afforded.



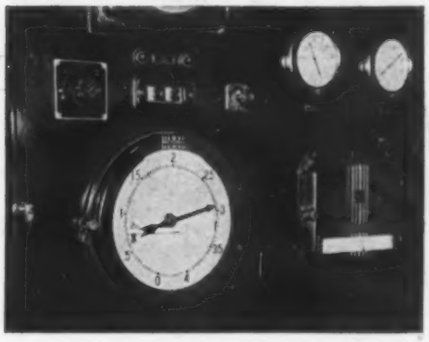
Typical L&N Open-Hearth Control Panel in shop of Pratt & Letchworth Co., Buffalo, N. Y. First Helper, in picture at left, is changing the setting of the automatic Furnace Pressure Controller; this instrument will regulate by means of the damper drive shown directly above. Other instruments automatically control the fuel-air ratio, reverse the checkers and record or indicate the flows and pressures involved in the operation of the Furnace to produce in minimum time steels of predetermined analyses.

"OPEN-HEARTHING" OF STEEL Is Speeded By L&N Controllers

Automatic controllers for open-hearth furnaces were very distinctly on a"make-good" basis when first installed on one of the furnaces of Pratt & Letchworth Co., manufacturers of steel castings for railroad and other severe services. The Controllers got a fair break in this plant; they were given every chance to succeed. But, P & L had been making fine steel castings long before any controller was known, and the firm would naturally make no changes in its established procedure unless it could discover an open-hearth regulation which was definitely better than the methods it had so long and so successfully employed.

Changing the setting of the automatic Micromax Reversal Control equipment. This reversal by temperature instead of time is usually the first unit to be installed in a complete furnace-control system.

The use, today, of L&N Automatic Controllers on all five of the P & L open-hearths shows to what extent the company succeeded in its search for improved furnace regulation of the draft, combustion and reversal, as factors in making alloy steels. The chemical and metallurgical reactions which create steel took on a new uniformity and speed when the controllers appeared. Skeptical First Helpers found it easier to run their furnaces smoothly; easier to get and hold the precise analyses required. They now know that a charge is ready to tap in less time; that it requires less oil; that the furnace refractories last longer.



Fuel-Air Ratio Control makes furnace gases either oxidizing, neutral or reducing, as decided by the First Helper. He sets fuel-oil feed manually, then sets proper ratio between fue and air by the knob in upper left corner of illustration. Oblong instrument at right then sets the air-damper's controller to hold the desired ratio. Flow of oil is shown by the round-chart Micromax Recorder. Because this control meters, it is accurate regardless of changes in air pressure, thickness of oil, partial clogging of burners or other conditions.

Applicable to any type of open-hearth, L&N Controllers will be described on request. Ask for catalogs or engineering service, as you prefer.

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Trumbull Enclosed Industrial Multi-Breakers provide automatic overload and short circuit protection for vital light and power services, (Alternating Current up to 100 Amp. maximum) at a price comparable with fusible equipment.

They are intended for same purposes as more expensive "AT" Circuit Breakers . . . within the range of their ratings.

These Heavy Duty Multi-Breakers prevent unnecessary production delays, because after short circuit has been removed, there is nothing to replace or renew. Service can be restored immediately by simply throwing handle to "off" and then to "on" position.

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Write for Trumbullaid Circular 333 giving full details and specifications.

Availability

Available in two sizes for 230 V. AC only. 2 and 3 pole.

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Type M-1, 50 Amp. frame size, rated 15 to 50 Amps.

Type M-2, 100 Amp. frame size, rated 50 to 100 Amps.

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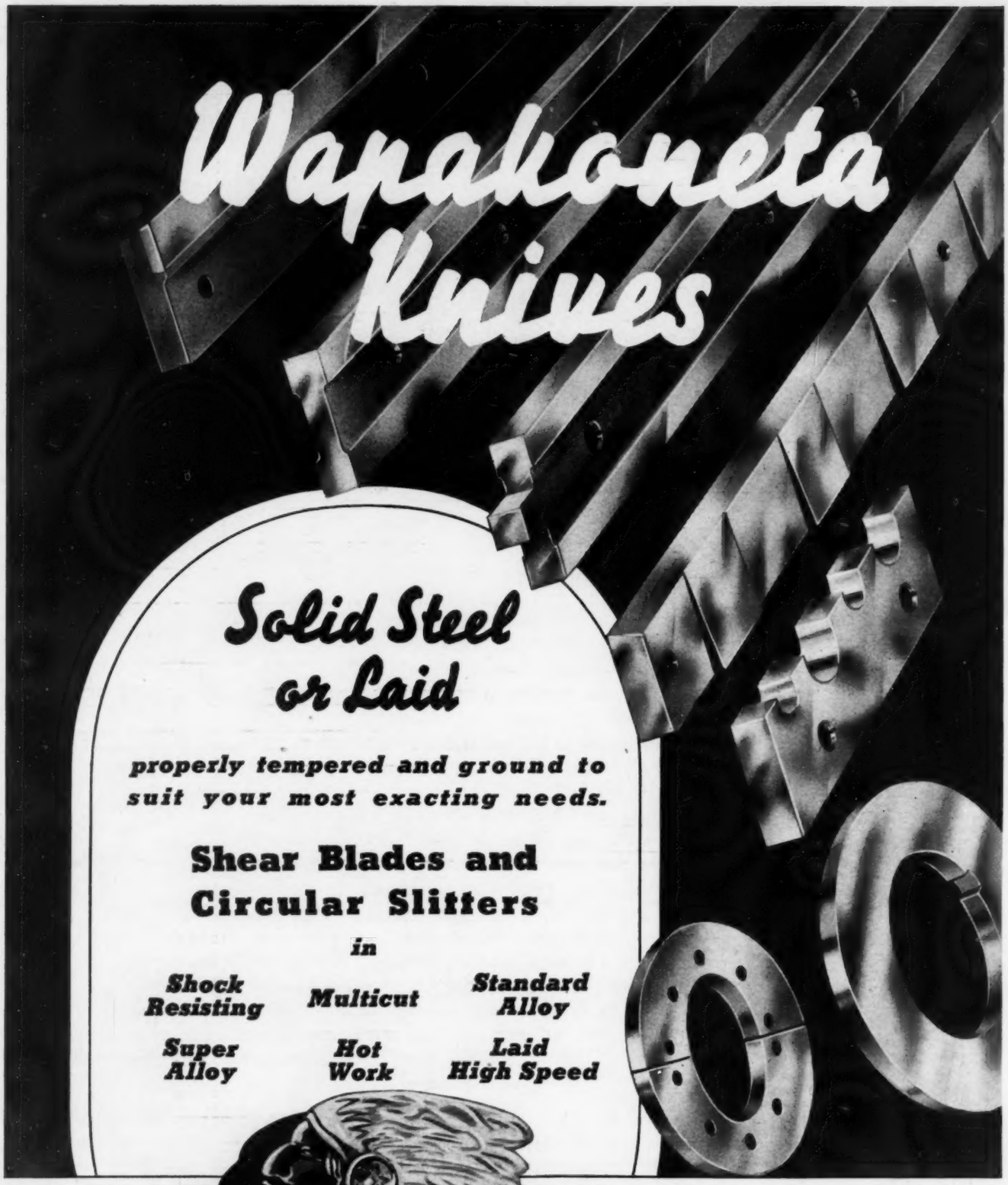

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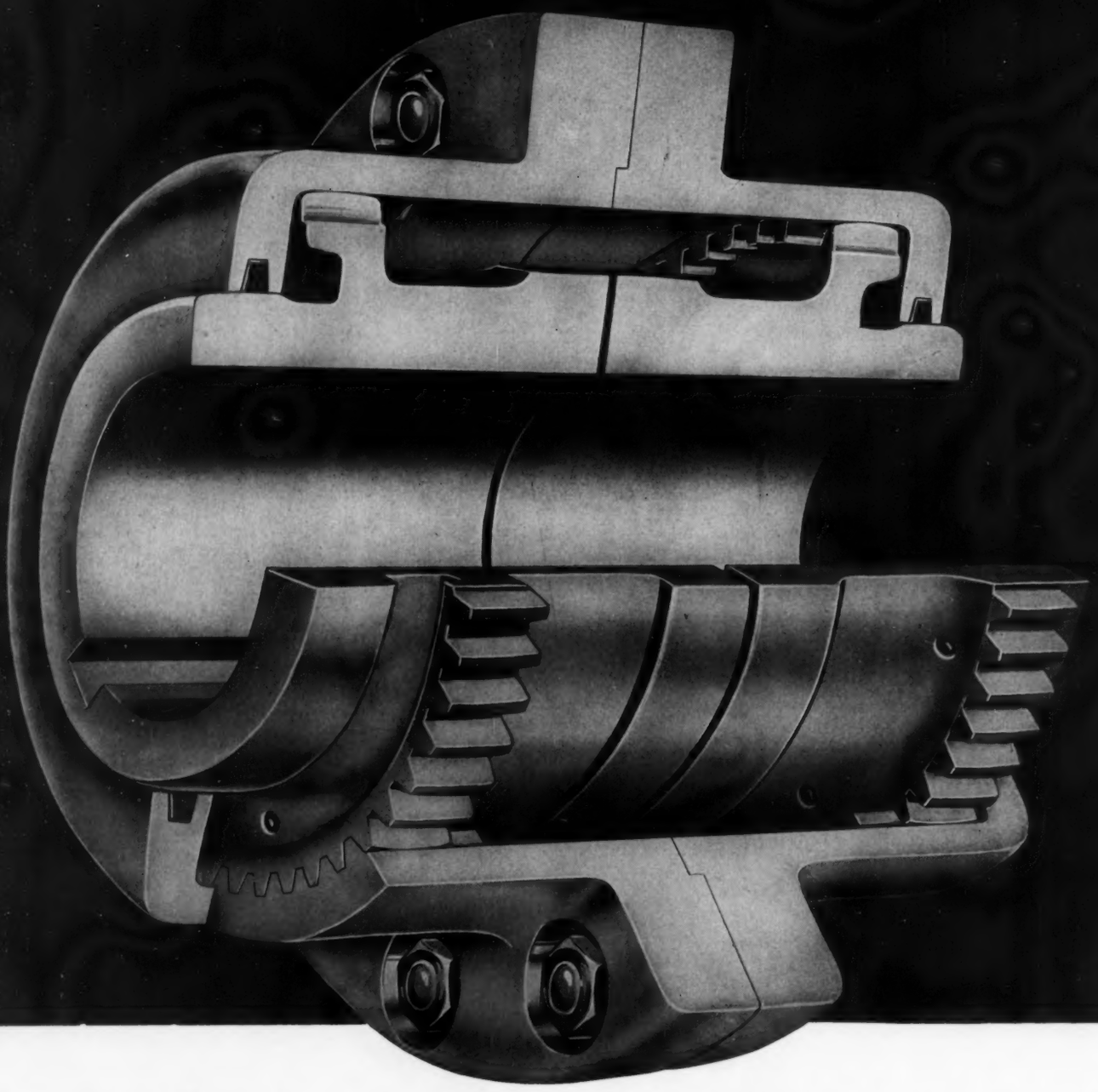

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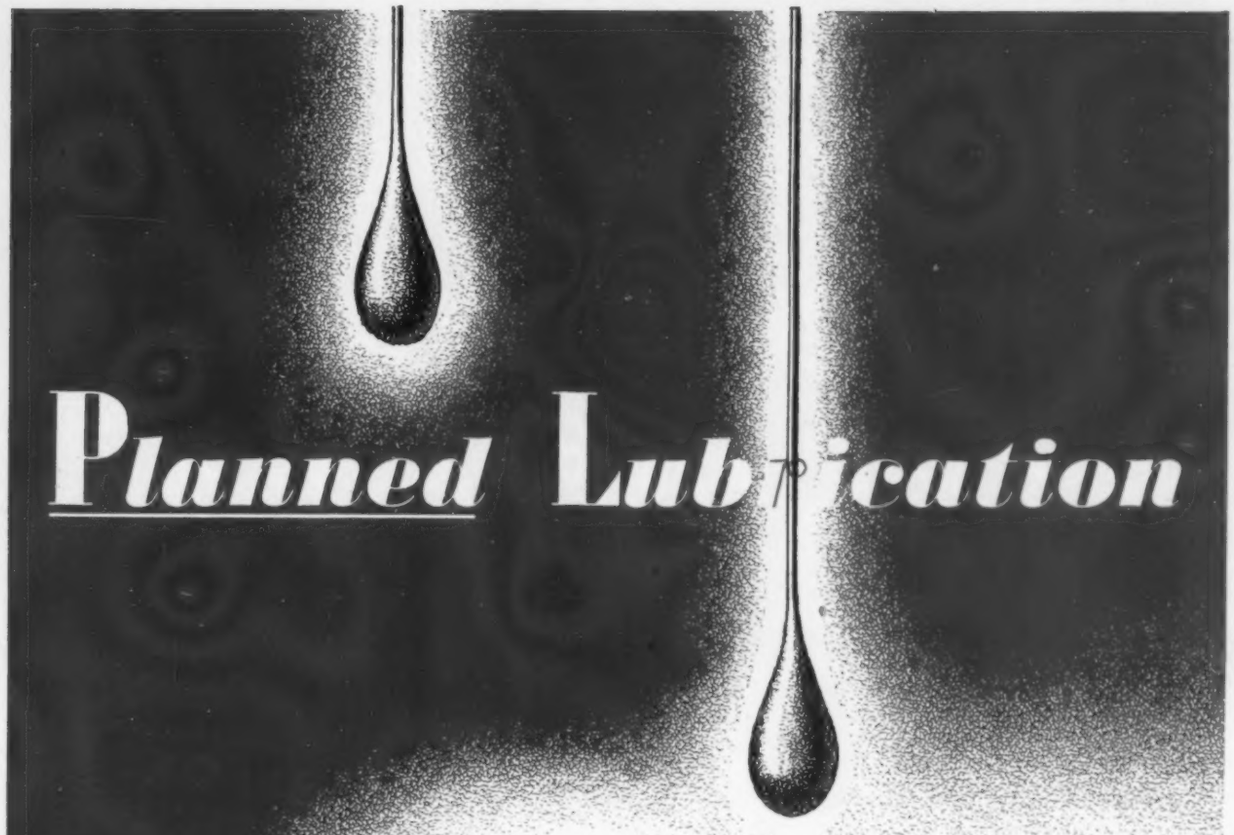

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The man who knows how his machines can best be lubricated for long life, how to reduce inventories, and how the over-all cost of lubrication can be kept low, will be a valuable man to his company in the competitive era to come.

Now is the time to study your plant's lubricating requirements as a whole. You can obtain specialized help on this subject from Houghton lubrication engineers who know both theory and practice. They can help you work out a simple, flexible plan, using lubricants fortified for greater load-carrying capacity, leak resistance and oxidation stability, so that your machines will be protected for the years ahead.

This service is freely offered, limited only by prior demands on our engineers' time. Why not talk with the Houghton Man about the plan and the scientifically treated lubricants which will make it work? Write E. F. HOUGHTON & CO., 303 West Lehigh Avenue, Philadelphia 33, Penna.

Houghton's **FORTIFIED** *Lubricants*

WHEN BOWSER EQUIPMENT WENT TO WORK,

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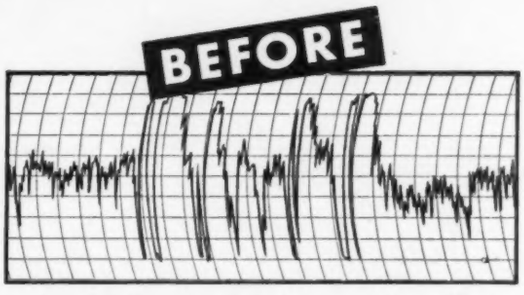
Standard Gage, in its grinding operations, works to .0001, after which the gages are lapped to the final tolerance. Abrasions, due largely to particles in the unfiltered coolant, were causing regrinds averaging 25%.

Bowser Pressure Filters were installed . . . and *regrinds dropped to less than 5/10 of 1%!* Picture that in terms of savings in time, labor and money!

Bowser Filters are only one of the many types of Bowser equipment that are helping American manufacturers build more, faster, better—and usually with real money-saving.

The steel industry, possibly more widely than any other, depends on Bowser. Bowser lubrication systems are standard in more than 90% of American mills. Bowser systems become actually an integral part of the mill itself, for they are engineered individually to the exact specifications and requirements of the mill. Besides lubricating mill stands, pinion gear sets, reduction gears, turbines, turbo-blowers and pumps, Bowser equipment also provides coolant filtration and circulation, the filtration of air conditioning system solutions, the metering of fuel oil, etc. BOWSER, INC., Fort Wayne 5, Indiana.



Surface variations (graph lines represent five-millionths of an inch) after a finish-grinding with unfiltered coolant oil prepared only 2 days previously. Scratches, scarcely visible, were deep enough to necessitate regrinding.

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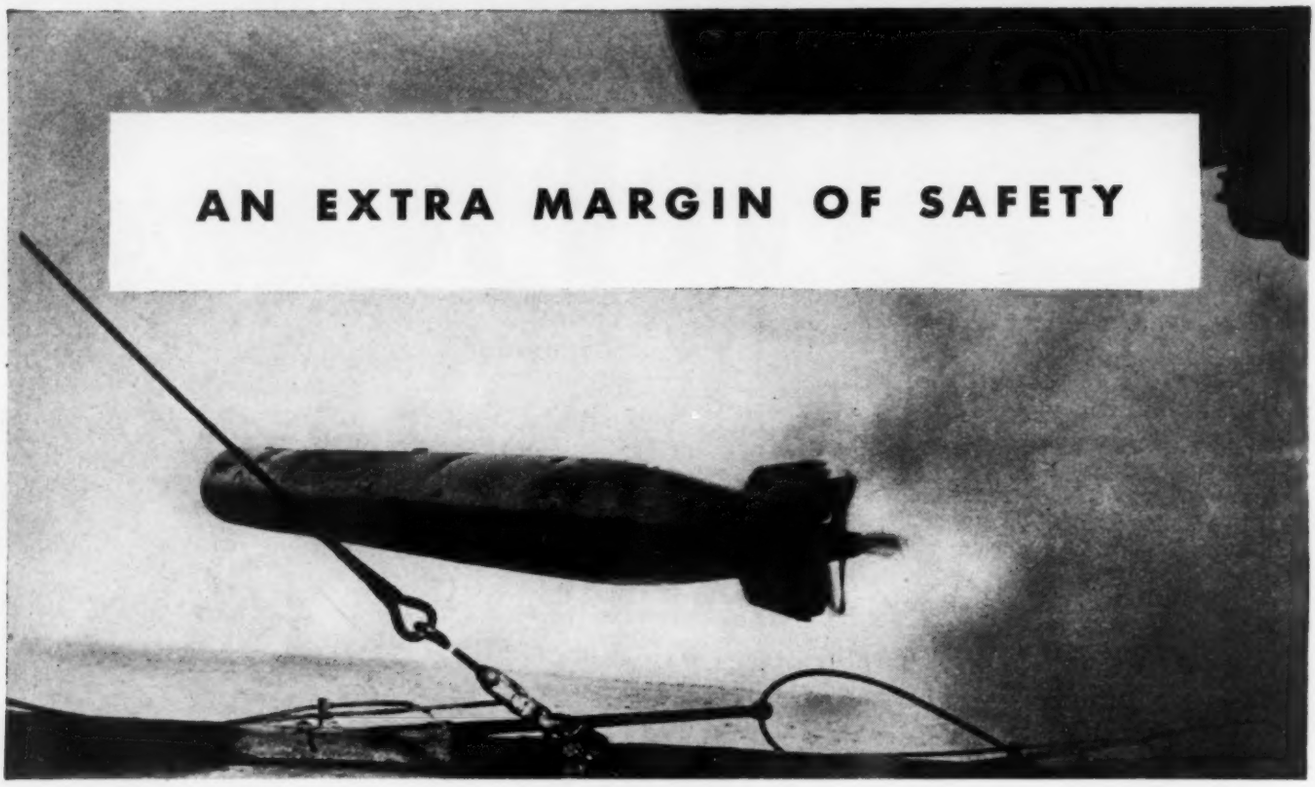
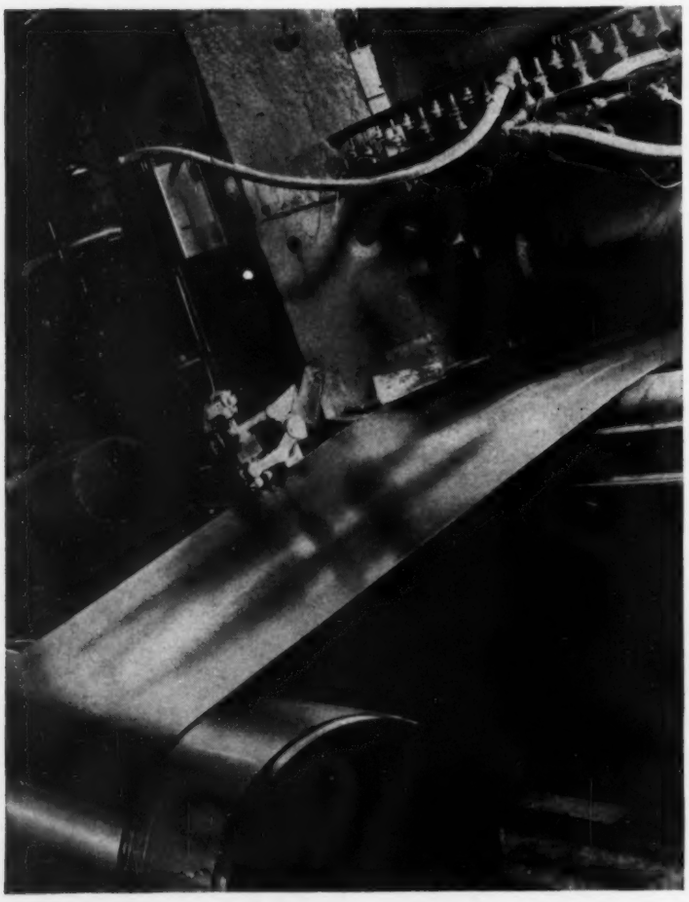


AMERICAN TORPEDOES, fired from fighting ships, submarines or torpedo-bombing planes, have sunk a good part of the Jap navy. Despite their devastating power, torpedoes are "safe" to the men who fire them—for they not only are on "safety" until discharged, but also must travel a certain distance through the water before the fuze-trigger is "cocked" for detonation!



EXTRA SAFETY must be given to steel mill equipment, too—for America cannot afford breakdown or slow-down on this important production front. Penola Lubricants provide this extra protection—for each Penola steel mill lubricant has an operating margin of safety over and beyond ordinary operating temperatures and pressures. This margin of safety is one big reason why more Penola Lubricants are used in American steel mills than any other brand.

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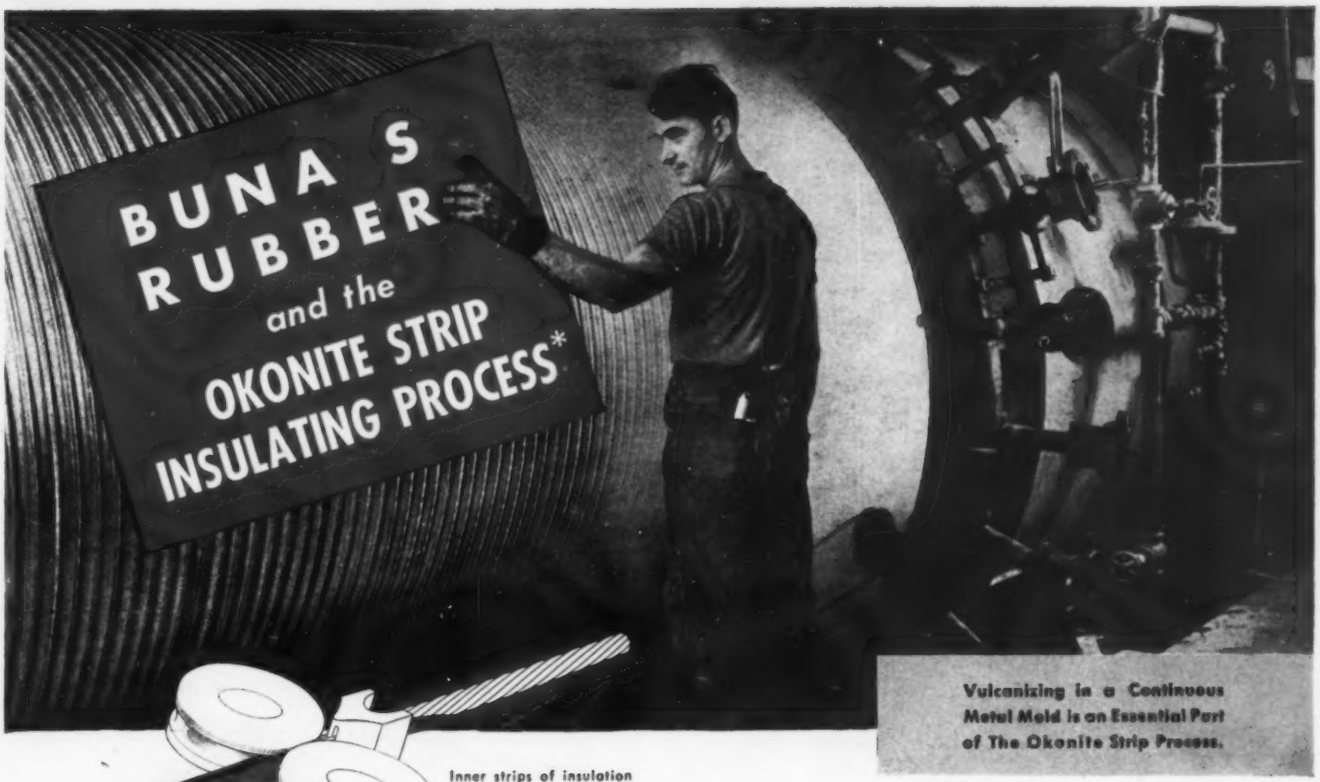

Vulcanizing in a Continuous Metal Mold is an Essential Part of The Okonite Strip Process.

Inner strips of insulation are folded about the conductor.

Pure tin backing on the final layer forms a continuous metal mold.

With metal mold removed after vulcanization, the finished cable is ready for testing and shipment.

LOOK FOR THE SINGLE RIDGE

* THE OKONITE STRIP PROCESS

The Okonite Strip Insulating Process is a unique and superior method of applying rubber insulation to a conductor.

Strips, cut from uniformly calendered sheets, are passed through "covering wheels". These strips are formed or folded lengthwise about the conductor and thus insure perfect centering.

One continuous operation is used to apply at least two or more layers, as required, the outermost layer being a strip with tin backing.

The insulated conductor is thus temporarily encased in a continuous tin mold. It is wound around a drum of large diameter, ready for vulcanization. The metal mold provides uniform heat distribution throughout the length.

After the cable has cooled, following vulcanization, the tin backing is peeled off as the finished wire is unwound from one reel and wound on another.

BECAUSE of the rubber shortage, *all* manufacturers have been forbidden by the government to use natural rubber in wires and cables for commercial use.

In 1942 it became apparent that Buna S would be the principal synthetic rubber to be used for insulation. Using Buna S synthetic rubber is not a new process for the Okonite Company. In 1939, before hostilities began, the Okonite Research Department had imported Buna S from Europe and soon found out how to use it in place of the small amount of natural rubber used in Okolite, an oil base insulation.

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While the industry, as a whole, is using Buna S rubber extensively, *only* Okonite uses the complete Strip Process to apply it. The Okonite Company, Passaic, New Jersey.

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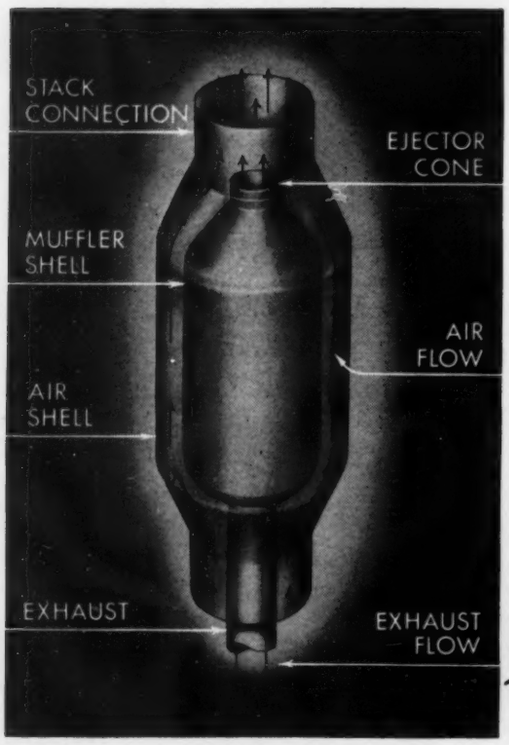

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HERE'S a Keystone "hard-to-beat" combination for deadending heavy cables. Long clamping surface provides positive grip on conductor. Note clamp is round and of small diameter to facilitate taping and is free of sharp projections which might pierce tape insulation. In combination with the Keystone Giant Strain Insulator which is porcelain covered for all weather service and backed by over 30 years of unfailing service you have a "hard-to-beat" combination. You can do a better, longer-lasting job with Keystone.

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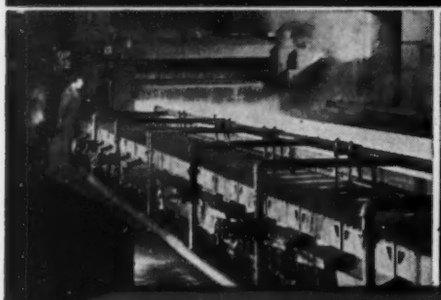
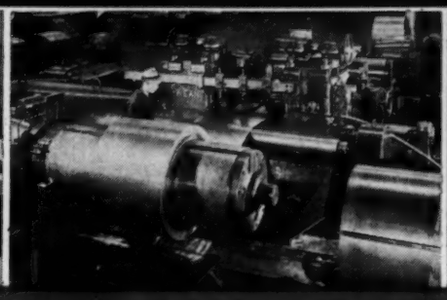
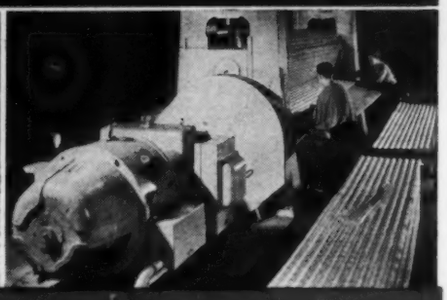
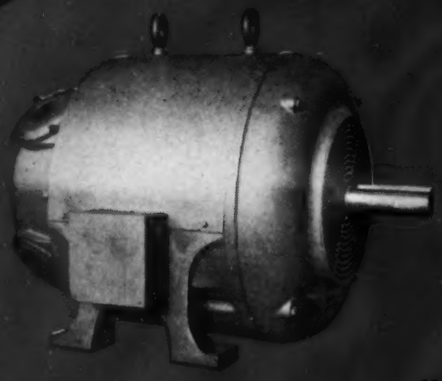
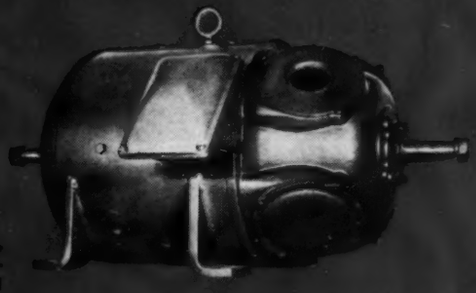




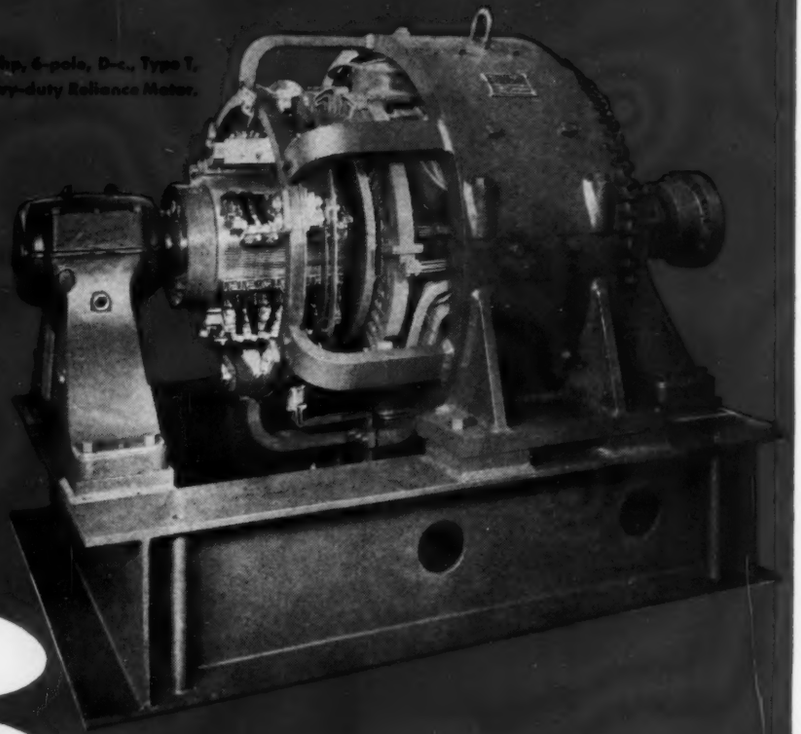


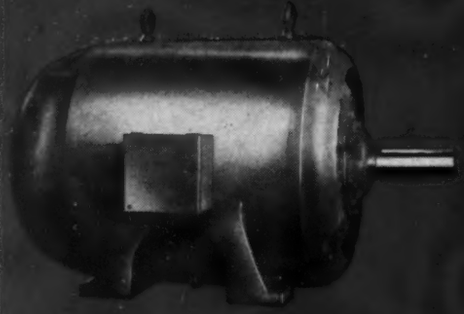
Fully-enclosed, Dust-tight, D-c., Type T, Heavy-duty Motor for steel-mill auxiliaries. Designed for rapid acceleration and quick stopping.



For adjustable-speed drives, Enclosed, Fan-cooled, D-c., Type T, Heavy-duty Motor. Vital parts kept clean and dry.

500 hp, 6-pole, D-c., Type T, Heavy-duty Reliance Motor.





Protected against dirt and moisture. A-c., Enclosed, Fan-cooled Reliance Motor.

RELIANCE A·C D·C MOTORS

These are but a few from a variety of types of Reliance Motors that have won a good name for dependable service in mills producing, processing, and fabricating metals of all kinds.

RELIANCE ELECTRIC & ENGINEERING CO.
1088 IVANHOE ROAD • CLEVELAND 10, OHIO

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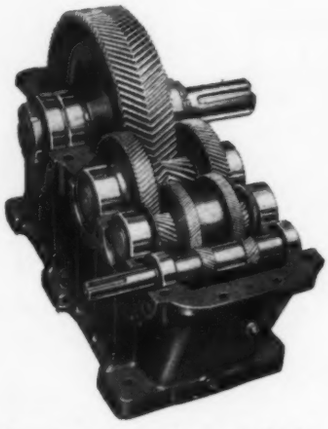
WHETHER IT'S THIS —OR THIS

. . . both will stand up under war time conditions



The above view of a Jones Triple Reduction Herringbone Speed Reducer is typical of a line that is noted for advanced design, superior materials, precision workmanship.

TWENTY FOUR hours a day operation plus loading up to rated capacity or beyond are testing speed reducers in every type of service.

Jones Herringbone Speed Reducers are establishing remarkable service records under these conditions. One reason of course is the fact that Jones Reducers have always been rated in accordance with the recommended practice of the American Gear Manufacturers Association.

With this conservative rating policy goes sturdiness, compactness, symmetry and balance—all factors that influence maximum efficiency, long life and improved performance.

Jones Herringbone Gear Speed Reducers are built in a wide range of ratios and ratings to cover every requirement. Single (Type SH) reducers in standard ratios range from 1.25 to 1 up to 11 to 1 in ratings from 1.3 to 440 H.P. Double (Type DH) reducers are built in standard ratios from 10.9 to 1 up to 72 to 1 in ratings from 0.5 to 275 H.P. The triple reduction reducers (Type TH) cover a range of ratios from 86.9 to 1 up to 355.8 to 1 in ratings from 0.3 to 78 H.P.

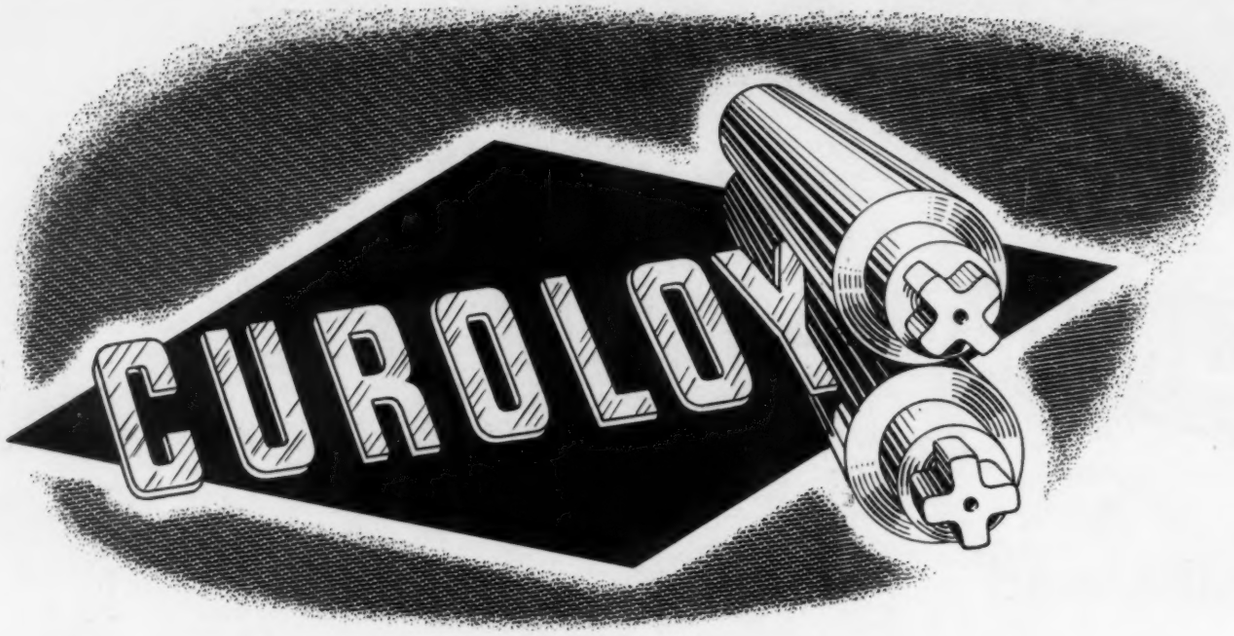
All these reducers have heat treated gears, ground shafts and are mounted with anti-friction bearings throughout. Cast iron bases are available for all variations of motor assembly.

For complete information on both standard and special applications of Jones Herringbone Reducers ask for Catalog No. 70. This 128 page catalog is a comprehensive technical treatise on the whole subject of Herringbone Reducer application for all conditions of service. If you have any type of drive problem that might call for Herringbone gears we shall be pleased to send you a copy.

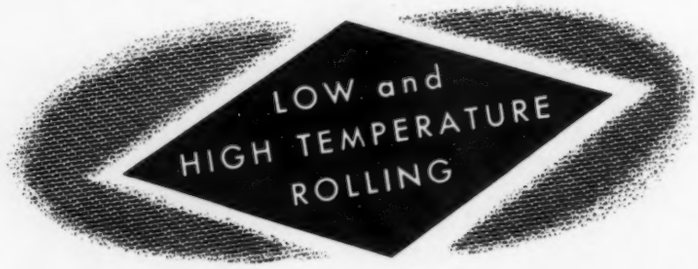
W. A. JONES FOUNDRY & MACHINE CO., 4431 **Roosevelt Road, Chicago, Ill.**

Jones

HERRINGBONE — WORM — SPUR — GEAR SPEED REDUCERS • PULLEYS
CUT AND MOLDED TOOTH GEARS • "V-BELT SHEAVES • ANTI-FRICTION
PILLOW BLOCKS • FRICTION CLUTCHES • TRANSMISSION APPLIANCES



The Birdsboro patented grain roll for Roughing, Semi-Finishing and Finishing of mild, alloy, tool and special steels; non-corrosive irons and steels; non-ferrous metal bars and shapes at



Available in four grades—Hard, Medium, Mild and Extra Mild to meet your specific requirements. If it's a roll problem, consult Birdsboro.

BUY WAR BONDS

BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY • BIRDSBORO, PENNSYLVANIA

BIRDSBORO
ROLLS

Different grades and makes of Insulating Firebrick have widely differing properties. To obtain the maximum value for a given application, select the brick that will best fulfill the following:

1—*Limiting Service Temperature*—
The group or grade of insulating firebrick is established by the maximum temperature at which your furnace will operate. Select the group or grade next above this temperature.

2—*Weight and Conductivity*—
Generally, the lighter the brick, the lower the conductivity will be. Heat losses can be kept at the minimum only by selecting the lightest brick with the lowest conductivity. Compare conductivities based on ASTM test C-182-43T. Do not compare results obtained by different testing methods; they cannot be correlated.

3—*Stability*—
Cold crushing strength does not always indicate the stability of an insulating firebrick under fire. Compare the hot-load strengths. This is an essential factor for spring arch and for high wall construction and an important indication of length of service to be expected.

4—*Durability*—
Insulating firebrick should show little or no permanent volume change after heating to their recommended temperature limits. Compare results based on ASTM test C-93-42.

5—*Responsibility*—
Consider the manufacturer's responsibility, his ability to produce uniformly high quality materials, and his knowledge and experience with applications of insulating firebrick to different types of furnaces.

6—*Value*—
An evaluation of benefits and advantages for your particular furnace application should be made as a final step. Price alone is no criterion—a low price may result in an expensive investment.

Your local B&W representative will be glad to give you the necessary information on B&W Insulating Firebrick to make this kind of an evaluation.

THE BABCOCK & WILCOX CO. *Refractories Division* **85 Liberty St., New York 6, N. Y.** R-176

BUY MORE WAR BONDS!

BABCOCK & WILCOX

ARMY E NAVY

EXIDE ANNOUNCES A NEW MOTIVE POWER BATTERY

the EXIDE-POWERCLAD

MADE AVAILABLE NOW to relieve existing shortages, and to supplement the Exide-Ironclad, which will continue at peak production

FOR 34 YEARS Exide-Ironclads have been recognized as the world's most dependable and efficient motive power battery. As a natural consequence the demand for them has grown to a point where production has now reached its peak. An increase will not be possible for some time to come. To relieve this shortage another truly great motive power battery has been added to the Exide line.

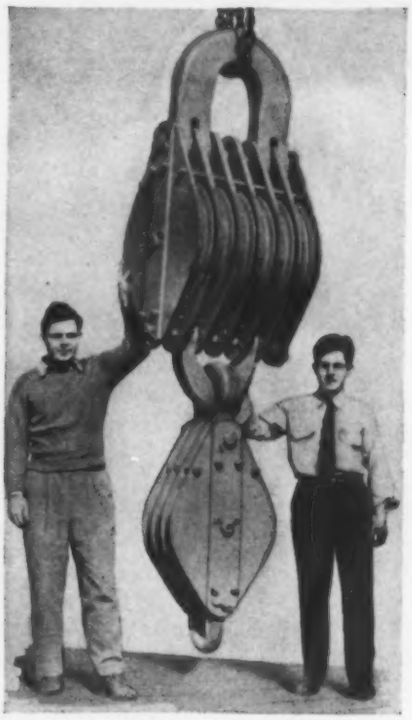
This new battery, the Exide-Powerclad, is not a stop-gap—not a "Victory" model—nor a composite of other battery parts. It is an entirely new battery—a result of approximately 12 years of specific and definite research, conducted for the purpose of developing a high-quality, flat-plate battery which will meet the most exacting needs encountered in motive power service. Its essential parts are of new, improved design, and are made exclusively for the Exide-Powerclad.

Based on extensive laboratory and service tests, we can assure motive power operators that performance and power costs will compare favorably with those of Exide-Ironclads. For further particulars write to Exide.

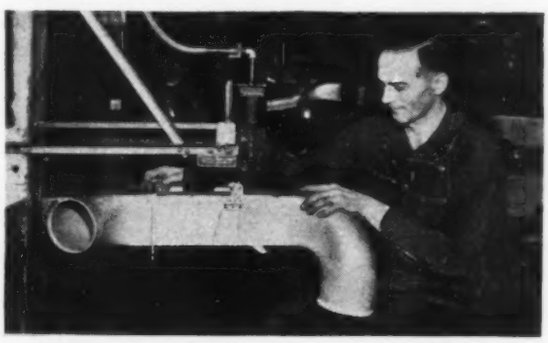
THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

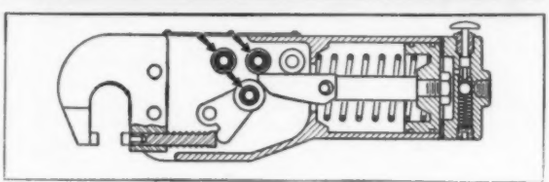
IN THE NEWS
WITH TORRINGTON BEARINGS

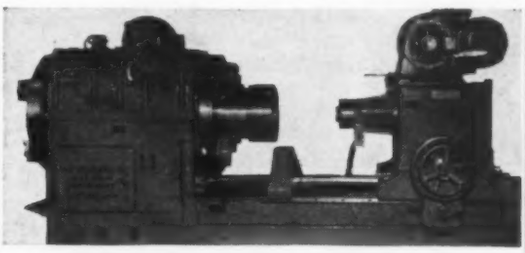
ALL IN THE DAY'S WORK typifies the attitude of Torrington engineers when they undertake the design and manufacture of anti-friction bearings for new or unusual applications. The skilled workman shown in the illustration is grinding the race for a precision bearing 10 feet in diameter, with a tolerance of two-thousandths of an inch. When you need counsel on standard or large, custom-built bearings, TURN TO TORRINGTON.

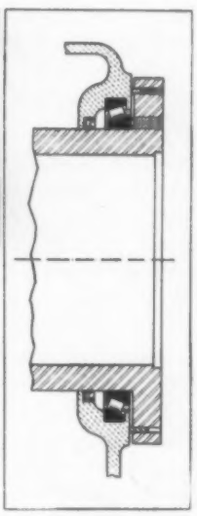


LIFTING 125-TON LOADS is the job of these tackle blocks designed and built by the Downs Crane & Hoist Company. With one block employing six sheaves, the other three, they are used in tandem to reeve the 19 parts of one inch wire rope required to sustain the load. Two NCS Needle Bearings, supplied by Torrington's Bantam Bearings Division, were installed in each of the sheaves which revolve on a 3" hardened and ground shaft, with the pin hollow bored for pressure lubrication. NCS Needle Bearings combine the advantage of high load capacity and compact design with ease of installation.









MILLING THREADS in 8" howitzers and 155 mm. guns is part of the important work performed by this Master Thread Miller, manufactured by the Smalley-General Company. To provide the essential accuracy at high speeds, and to take up the very heavy radial and thrust loads, both main and milling spindles are mounted in Tapered Roller Bearings, 30" O.D., as shown in the accompanying cross-section. Eccentricity and face run-out of these bearings is .0005 maximum—an example of the ability of Torrington's Bantam Bearings Division to build precision bearings for heavy-duty applications.

THIS CINCINNATI PNEUMATIC Squeeze Type Riveter, with a 3-ton compressive force, manufactured by the Schauer Machine Company, provides an interesting application for Torrington LN Needle Bearings. Selected because of their compact design and high load capacity, the bearings were installed, as shown in the accompanying cross-section, at the points where pressure is extremely high.

ARMY E NAVY

TORRINGTON BEARINGS

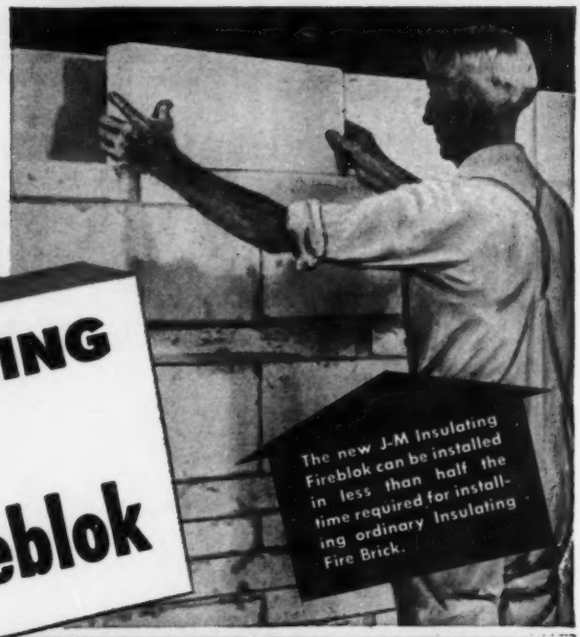
STRAIGHT ROLLER • TAPERED ROLLER • NEEDLE • BALL

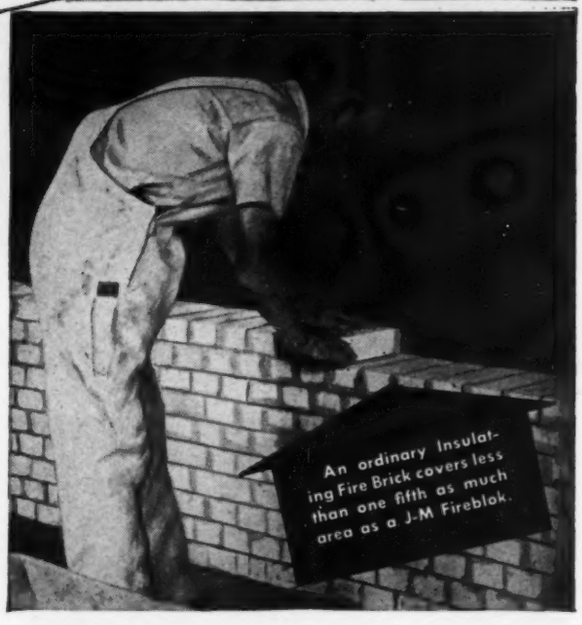
THE TORRINGTON COMPANY • BANTAM BEARINGS DIVISION

SOUTH BEND 21, INDIANA

LESS DOWN TIME

FOR FURNACE RELINING with big, new J-M Insulating Fireblok


The new J-M Insulating Fireblok can be installed in less than half the time required for installing ordinary Insulating Fire Brick.



ONE OF THE NEW LIGHTWEIGHT Johns-Manville Insulating Fireblok covers more surface than five Insulating Fire Brick. So, when you reline furnaces with it, you can often get the job finished several times faster. Consider how many hours this can save you in down time, in maintenance crew time . . . and how much faster your furnaces can get back into profitable production.

The larger, more convenient size is the only difference between J-M's four new Insulating Fireblok and the four well-knowr J-M Insulating Fire Brick. Either size of these four grades of highly efficient refractory linings for use from 1600° F. to 2600° F., has these important advantages:

Easy cutting and fitting—J-M Fireblok can be easily cut with a saw and shaped with a rasp. Most special shapes can be either shop or field cut from standard slabs, reducing the inventory of special shapes.

Minimum of joints—the large size, compared to the standard fire brick unit, materially reduces the number and length of joints, resulting in a thermally more efficient construction.

Economical bonding—with reduced joint length Fireblok requires a minimum of air-set cement for bonding. (J-M 1626 Cement was especially developed for this use.)

Uses—Fireblok can be used wherever Insulating Fire Brick are recommended such as for heat-treating furnaces, flues, stacks, mains and similar equipment. Also for the lining of doors, suspended arches, and, when tapered, for sprung arches of exceptional stability.

Write for new booklet, IN-103A, on this J-M development. Johns-Manville, 22 East 40th St., New York 16, New York.

MOST WIDELY USED BACK-UP INSULATION BETWEEN 600° F. and 1900° F.—J-M SUPEREX

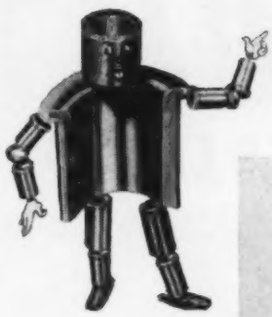
Made of high-quality, calcined diatomaceous silica and bonded with asbestos fiber, Superex combines all the desirable qualities of these two insulating materials. Result: High heat resistance and exceptional insulating efficiency. Ideal for boiler walls, furnaces, etc. Available in 3", 6", 9" and 12" by 18" and 36" blocks. Other lengths to order. Various thicknesses.

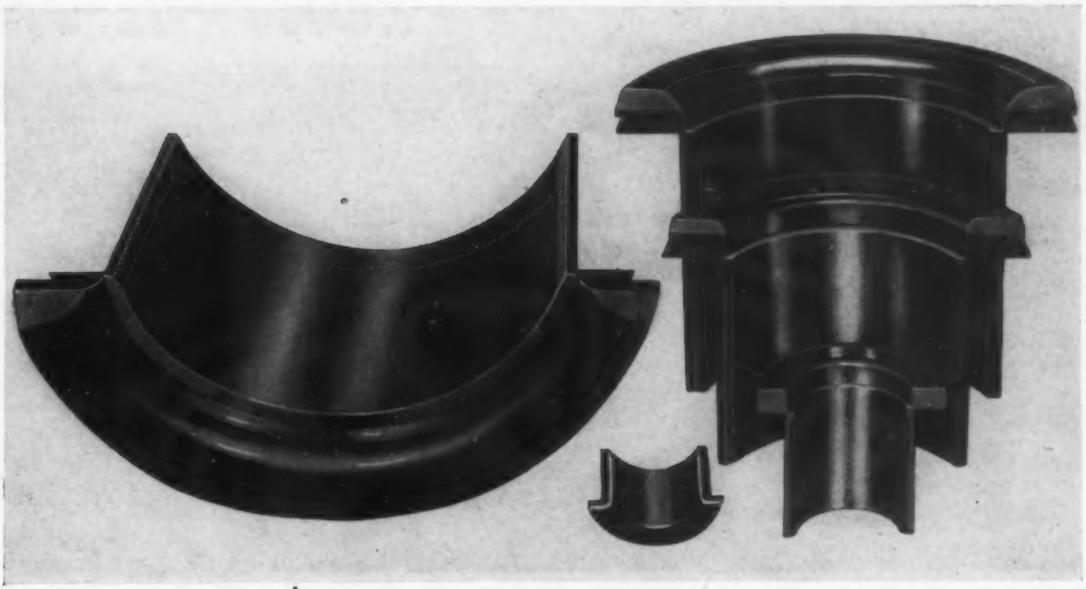
JOHNS-MANVILLE JM PRODUCTS

Johns-Manville
INDUSTRIAL INSULATIONS
FOR EVERY TEMPERATURE . . . FOR EVERY SERVICE

GATKE BEARINGS *Save Millions*

FOR THE ROLLING MILL INDUSTRY





GATKE Slipper Bearings revolutionize Universal Coupling performance. They stop deafening noise and vibration. Outwear bronze ten to one. Eliminate scoring and wear to sockets. Made to required size — no machining necessary. Send specifications for quotation.

Annual earnings and savings exceeding $60,000 directly traceable to GATKE Bearings on a small Merchant Mill are reported by the superintendent.

These substantial benefits resulted from more accurate maintenance of gauge, elimination of hot necks and neck breakage, reduced maintenance costs, power savings, etc.

Immeasurable benefits such as continuous operation, increased production, fewer screw-down adjustments, and reduced load on driving equipment were considered of equal importance to the substantial traceable economies.

These results are typical of GATKE Bearing performance on hundreds of mills.

Write for literature or send data on your mill for recommendation.

GATKE CORPORATION
228 N. La Salle St. Chicago 1, Ill.

Other **GATKE PRODUCTS**
Brake Lining
Clutch Facings
Friction Blocks
Silent Gears
Pump Valves
Piston Rings
Sheet Packings

Gatke NON-METALLIC MOULDED FABRIC Bearings

For Roll Necks, Universal Couplings, Spindle Carriers, Table Rolls, Cranes, Acid Resisting Service, and Other Tough Jobs.

Quick-As-Wink

• • • CONTROL VALVES

Four-Way Foot Operated Quick-As-Wink Valve with Compound Exhaust Position

Compound exhaust four-way valves are suitable for the control of double acting cylinders. Compound exhaust position is obtained by placing foot on both pedals simultaneously, in which position both valve units are closed to live air and open to exhaust as shown in Fig. 1.

One pedal may be depressed from the middle position connecting one end of air cylinder to live air with other end open to exhaust. Depressing the other pedal reverses the cylinder action. When both pedals are leveled again to the middle or neutral position, both ends of the cylinder are open to exhaust.

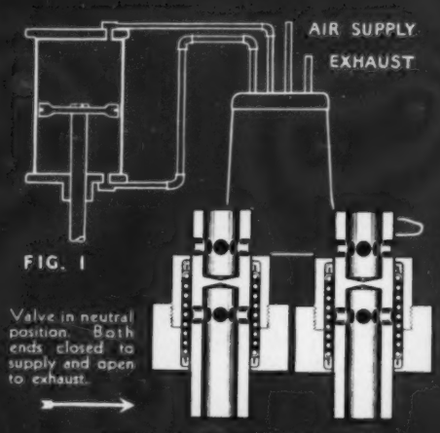

AIR SUPPLY
EXHAUST
Valve in neutral position. Both ends closed to supply and open to exhaust.
Position of valve units. Both are off to supply and open to exhaust.

FIG. 1

THE HIGHER THE PRESSURE — AIR WATER OIL — THE TIGHTER THE SEAL

C.B. HUNT & SON

Salem, Ohio

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Welding at temperatures below the fusion point of base metals is made possible by employing the phenomenon of surface alloying. Joints welded with EUTECTIC *Low Temperature* Welding Rods are *smoother, stronger, better color matched* and *more machinable* than those obtainable *by any other welding or brazing process.*

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The Eutectic Welder is published by the Engineering and Research staff of the Eutectic Welding Alloys Company and is supplemented by valuable contributions from enthusiastic users in all fields of industry and manufacturing.

These features each month keep you posted on all developments and up-to-the-minute welding news

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EUTECTIC WELDING ALLOYS COMPANY, 40 Worth Street, New York 13, New York Room 1112d.
Originators of Eutectic *Low Temperature Welding*
Please send me the latest issue of *The Eutectic Welder* and place my name on your regular mailing list.

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FIVE BIG STEEL COMPANIES USE
106 Fitch Recuperators

Here's why! Longer life and greater accessibility. Fitch Recuperators usually last much longer than other types and when repairs eventually become necessary, they can be made in a few hours' time, simply by replacing a few tubes. Practically every steel company that has ever installed a Fitch Recuperator, has later ordered additional ones.

Fitch Recuperators are scientifically designed and made of the most practical materials. With Fitch Recuperators there is less leakage and more heat transfer. Take less space—an asset where space is limited.

★ ★ ★

Used by big steel companies in Strip, Structural, Wire, Rod, Slab, Billet and Tube Mills. Write for Booklet 12 today.

Fitch Recuperator Company
Plainfield, N. J., U. S. A.

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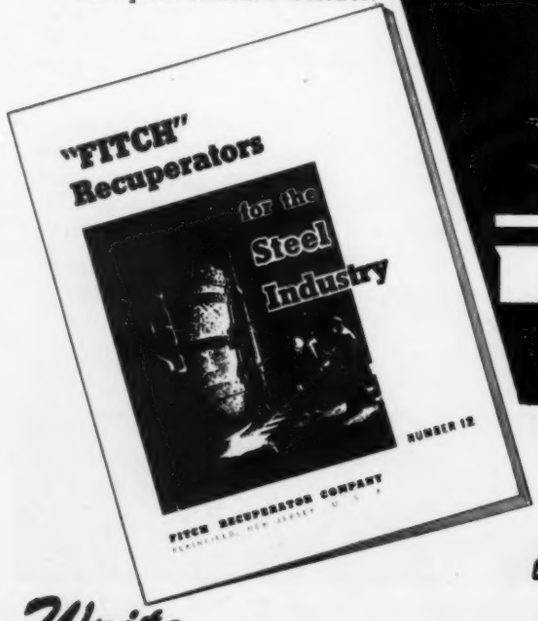
see your furnace builder.



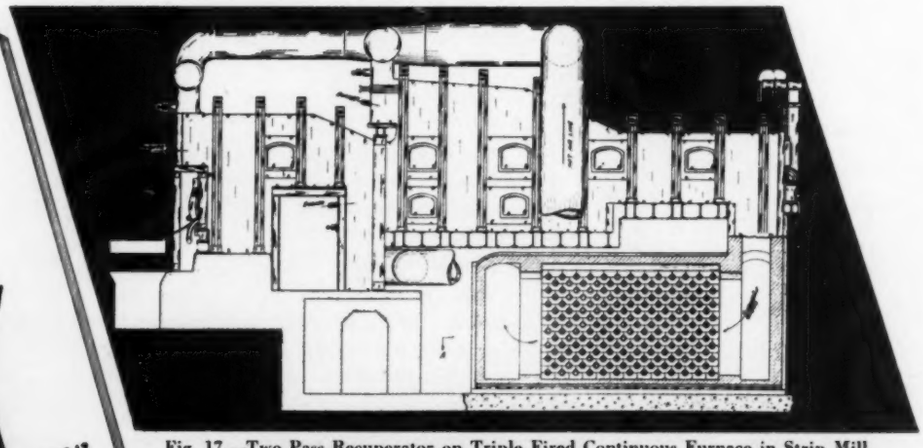


Fig. 17.—Two Pass Recuperator on Triple Fired Continuous Furnace in Strip Mill.

Write TODAY FOR
BOOKLET No. 12

FITCH *Recuperators*

PLAINFIELD. NEW JERSEY. U. S. A.

NEWS SUPPLEMENT September, 1944

Equipment
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Iron AND Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

WEIRTON STEEL MAKES PLANT RECORD FOR CONTINUOUS HOT STRIP PRODUCTION

▲ For the second time this year, a new monthly production record has been set on the Weirton Steel Company's 48-inch continuous hot mill which was the first completely continuous mill to be placed in operation anywhere in the world.

Production on the mill in August was 95,755 tons comparing with the previous record of 93,453 tons which was set in March 1944. Prior to this year the mill's record production was 92,978 tons in March 1942.

According to Weirton officials, the August tonnage of the 48-inch mill represents more than three times the capacity for which the mill was originally designed although no changes have been made in the basic structure of the mill since it was installed. The only major alterations in the mill's equipment were installation of larger and faster heating facilities and an increase in the amount of electrical power on the finishing rolls.

Built in 1926 and 1927, the 48-inch mill rolled its first steel in August 1927. Although other mills were placed in operation shortly before this time which had semi-continuous features, the Weirton mill was the first in the world that was completely continuous and thus able, in one operation, to convert a thick slab of steel into an unbroken coil of thin gauge metal. The original capacity was 30,000 tons per month.

When built, the mill was equipped with three single firing zone furnaces with hearths 12 feet, 6 inches wide and 50 feet long. The furnaces would heat slabs 10 feet, 6 inches long. In 1930 another furnace of the same size was added.

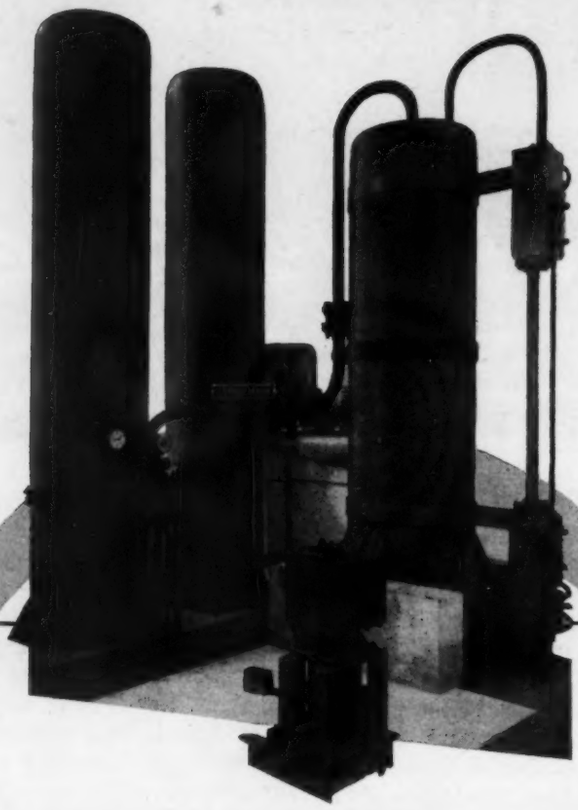
From 1935 to 1937 these furnaces were rebuilt to provide triple zone firing and increase the hearth size to 14 feet, 6 inches in width and 71 feet in length. This improvement made it possible to heat slabs 12 feet, 6 inches long in less time than the former furnaces required to heat the smaller slabs. The long slabs also were almost twice as thick as the short slabs. As a result furnace output was increased from 75 per cent to 80 per cent in normal operating practice. An increase of 50 per cent in the amount of electrical power applied to the finishing stands made the mill fully capable of rolling the increased number of slabs made available by the new furnaces.

The slabs, which constitute the raw material of the 48-inch mill, are rolled on the blooming mill from ingots. Each slab weighs approximately three tons. When a heating furnace is fully charged a row of 17 or more slabs lies on its hearth. As a cold slab is introduced at the charging end of the furnace, the entire row is pushed forward one slab-width and, on the discharging end, a slab heated to proper rolling temperature emerges on to a conveyor which places it on the table of the mill.

The 48-inch mill consists of ten stands of four-high rolls with one

SECTIONAL BRIDGES SPEED WAR MANEUVERS

The Bailey bridge, named for a British engineer, units for which are produced by Virginia Bridge Company, United States Steel Corporation subsidiary, has been credited with much of the speed of pursuit in the African, Italian and French campaigns. It can be put together by any military personnel, since it comes in prefabricated sections, ready for immediate field use. A solid floor is provided, capable of carrying tanks and similar heavy equipment. A simple steel pin secures the joints, tying together the required number of units.



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COMPLETE HYDRAULIC SYSTEMS

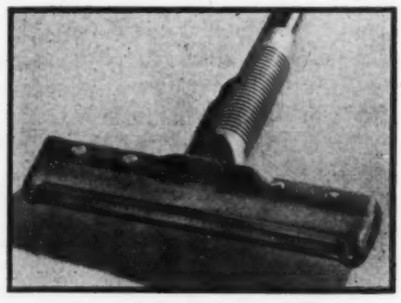
SCHLOEMANN
ENGINEERING CORPORATION
1102 EMPIRE BLDG. - - - PITTSBURGH, 22, PENNA.
HYDRAULIC PRESSES • ROLLING MILL MACHINERY

stand serving as a scale-breaker. As it enters the first roll stand, a large slab is 5⅜ inches thick and 14 feet, 6 inches long. Retaining the same width, the slab becomes thinner and longer as it passes through the rolls at a rate of about 12 miles per hour and, after passing through the tenth roll stand, is reeled in a coil of steel 85 one-thousandths of an inch thick and 800 feet long.

In order to establish the August record, it was necessary to roll an average of from 50 to 55 large slabs per hour or as many as 100 smaller slabs per hour. The output of the 48-inch mill is manufactured into a wide range of flat rolled steel products.

NEW DEVICE FOR FLAME PRIMING AND DESCALING

The Victor Equipment Company has introduced a new Victor standard descaling attachment which is easily attachable onto any standard Victor welding torch butt. It can also be furnished with torch butt to those who are not owners of Victor equipment.



This particular flame priming and descaling nozzle has many advantages:

1. It is provided with an unusually well-designed spiral mixer and gas proportioner to handle with greater efficiency the larger gas volumes required for these operations.
2. This mixing device virtually assures freedom from back-fire or flash-back.
3. In order to keep pre-mixed gases below ignition temperatures, even within the proximity of the ribbon flame and deflected heat, an Air-adiator aluminum cooling section is incorporated at the nozzle head.

4. Replaceable Meehanite skid shoes with properly shaped lugs add substantially to wearing life of the nozzle and allow it to be dragged at any suitable angle over the metal surfaces to be cleaned.

This nozzle is made in 4 in. and 6 in. ribbon flame widths. For inaccessible areas or rivet heads, special circular multi-flame nozzles are available.

LARGE WOOD-BURNING LOCOMOTIVES FOR AFRICA

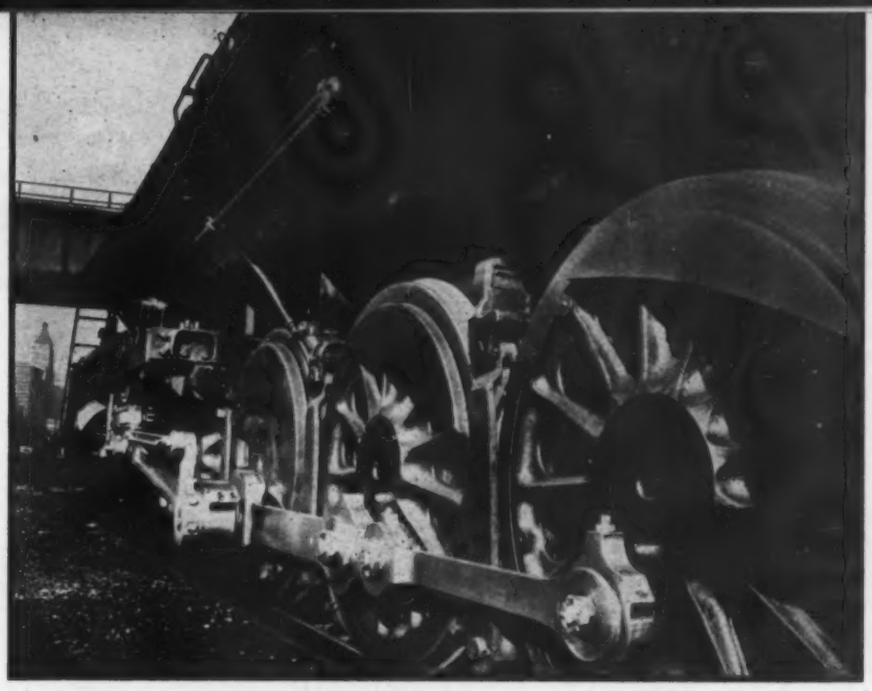
▲ Weighing 229,000 lb each with tender, two unusually large wood-burning narrow gauge locomotives have recently been completed and shipped by H. K. Porter Company, Inc., of Pittsburgh, Pennsylvania, for service on the "Grand Lacs Railroad" in French equatorial Africa.

Running on a 1000 mile single track line through the famous equatorial forest from Stanleyville on the Congo River to Albertville on Tanganyika Lake, the engines will use wood from the forests for fuel, there being no coal or fuel oil in that part of Africa. Native crews will man the engines exclusively.

The locomotives are built with large fireboxes and boilers for hauling heavy loads on long uphill grades which characterize the route. Their gauge can be changed from 39⅜ inches to 42 inches with only minor mechanical changes with a view to future possible use on connecting roads.

Heavy military transport is now being hauled on the "Grand Lacs" road, in addition to such raw materials as copper, tin, wolfram, tungsten, coffee, cotton, rubber, gold. The road connects with the Tanganyika Railway, forming one of the main links in the transport system across the continent which terminates on the east coast at Dar-es-Salaam.

The locomotives are of the Mikado type, class 2-8-2, with 19 in. x 22 in. cylinders, and eight driving wheels of 48 inches diameter. Approximate weights are engine total 144,000 lb and drivers 106,000 lb, tender 85,000 lb. Tractive force is 28,125 lb; factor of adhesion 3.7; height 11 ft 10 in.; width 9 ft 8 in.; length over bumpers 57 ft 3 in. Boiler is straight radial type, of 62 in. diameter, designed for 200 psi pressure. Firebox has a width of 53 in. at the top and 72 in. at the bottom. Grate area is 42 sq ft. Tender holds 4500 U. S. gallons. Fuel capacity, wood, is 600 cu ft.



SHOES FOR THE IRON HORSE

The great "iron horse" remains the pride of America, and today it is better shod than ever for its great task of transporting the men and material of victory. The power of the iron horse is vividly suggested by the illustration above, and the technical perfection of the Union web-spoke driving wheel centers makes itself apparent to the expert. Adaptable for front, back and intermediate positions, modern design gives them unequaled resistance to shock and wear, and eliminates internal stresses. They are made by Blaw-Knox's Union Steel Castings Division, Pittsburgh, Pennsylvania.

One of the unusually large, wood-burning, narrow-gauge locomotives recently completed by H. K. Porter Company, Inc., of Pittsburgh, Pennsylvania, for service in French equatorial Africa. Weighing 229,000 lb with tender, the engine is shown during test in the Porter yards. In use it will be manned entirely by native African crews.

FIFTH ANNUAL WATER CONFERENCE TO BE HELD

▲ The fifth annual water conference under the auspices of the Engineers Society of Western Pennsylvania will be held at the Hotel William Penn, Pittsburgh, Pennsylvania, October 30 and 31. Under the general chairmanship of H. M. Olson, a comprehensive program has been arranged with morning and afternoon sessions on both days. A dinner session is also scheduled for the evening of October 30.

Just Announced!

REVOLUTIONARY NEW "PHILCO THIRTY" GIVES 30% LONGER LIFE!

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At last, a motive power battery with a revolutionary, new construction that actually gives you *30% longer life . . . and more!* A brand new principle of fabricated insulation . . . developed after years of research in the Philco laboratories, and now introduced after exhaustive tests in actual service. It's the *Philco "Thirty"* . . . your post-war battery, available now in certain types and limited quantities. Write today for full information.

PHILCO CORPORATION, *Storage Battery Division, Trenton 7, New Jersey*

FOR 50 YEARS A LEADER IN INDUSTRIAL STORAGE BATTERY DEVELOPMENT

PIPE MILL INSTALLED BY REPUBLIC STEEL

▲ A record of twelve days was set by the Youngstown District of Republic Steel Corporation in connection with the installation of equipment for making 6 in. diameter invasion pipe of ⅛ in. wall thickness.

Authorization to install the equipment was received from Defense Plant Corporation on July 29th, 1944. The mill began to arrive at the plant on August 13. The first pipe was produced on August 25.

Included in the installation, which required a floor space 278 ft x 36 ft, were 165 tons of machinery and 22 electric motor drives, the largest a 200 hp unit. Also installed were a coil box, a leveler, side trimmer, cleaner, tube forming mill, resistance welder, cooling, sizing, straightening and cut-off equipment and cut-off machine.

The new mill will supplement existing pipe-making facilities. No tangible figures on production can be given because of wartime restrictions.

EQUIPMENT MANUFACTURER GETS SAFETY AWARD

▲ The certificate of merit for safety has just been awarded Blaw-Knox Company by the Pennsylvania Department of Labor and Industry. The award covers the over-all operations of the company's plants in Pennsylvania for the calendar year 1943, and is based on the performance of Blaw-Knox in excelling the industrial safety average of the state. John P. Leonard, the company's director of safety, credits the achievement to a remarkable spirit of co-operation between safety-conscious employes and management officials.

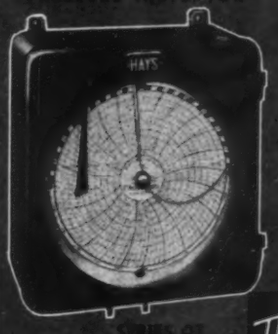
NEW FILLING COMPOUND FOR MAGNET CASES

▲ The Sterling Varnish Company, Haysville, Pennsylvania, has developed a new filling compound, designated as S-182, for lifting magnet cases, potting small transformers and for general filling work. It is a very firm material with considerable resiliency and withstands extremely high or low temperatures. S-182 compound has great internal cohesion, thus minimizing the danger of disintegration and severe stresses.

The compound is supplied in two separate parts: S-182A, a viscous liquid, and S-182E of low viscosity, which must be mixed immediately prior to use as they react slowly at room temperatures. However, the mixture retains sufficient liquidity for pouring for a period of four to five hours. Though very heavy, the compound penetrates into small interstices.

At 60-70 C, S-182 compound starts to set in about one hour and becomes well dried overnight. When baked at 105-110 C it reaches its maximum hardness in one to six hours depending upon the mass involved. Further baking of the compound has no marked effect. S-182 compound has a high dielectric strength, a low coefficient of expansion and is water resisting and oil proof. It will withstand temperatures up to 200 C without resoftening and does not become brittle at temperatures as low as minus 60 C.

A Real Aid to PRODUCTION



HAYS
OPEN HEARTH
PRESSURE CONTROL

TONNAGE can be increased through more even operation and even operation also means fuel saving. Automatic control of furnace pressure, rates of fuel and air flow, ratio of fuel to air, constant volume or pressure of oil or gas relieves the operators of many time-consuming details, allowing them to pay more attention to the steel making process.

When desired, the control of these various functions can be handled manually from a centralized panel through remote operation. Hays control is all-electric, simple to install, simple to operate, simple to understand.

The following Hays instruments may be used effectively in combination or separately for the functions indicated.

Type CDE-X Furnace Pressure Controller with external manual adjustment for automatically operating stack damper to hold pressure constant.

Series FOT Pressure Indicator provides an easily read measurement of furnace pressure. Usually connected at furnace roof.

Series OT Pressure Recorder provides daily record (24 hr. chart) of furnace pressure. Shows timing of reversals and each change of pressure made by operator during the heat.

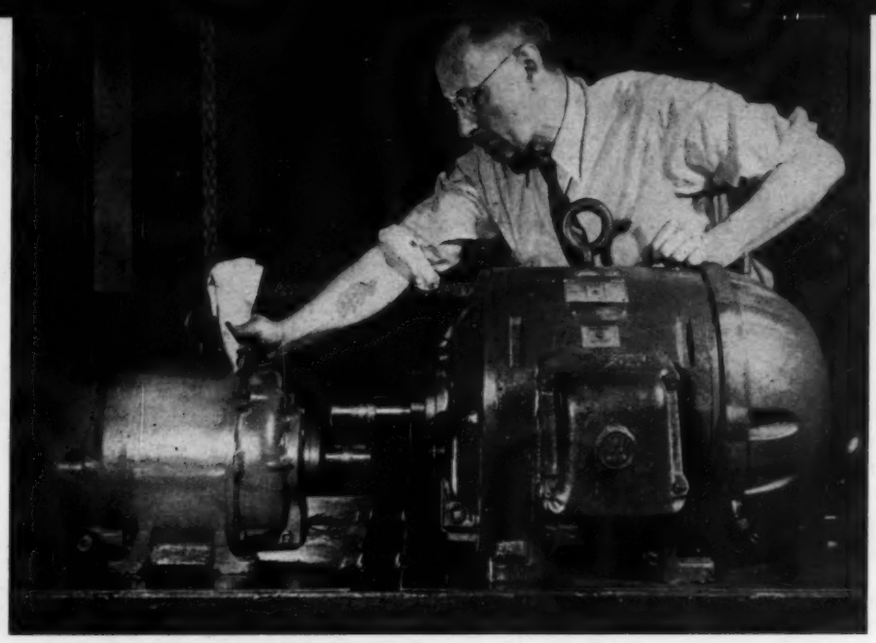
Hays partial or complete instrumentation is a REAL AID TO PRODUCTION. Hays representatives located in the principal cities of the U.S.A. and Canada will gladly supply complete information.

The HAYS CORPORATION
COMBUSTION INSTRUMENTS AND CONTROLS
MICHIGAN CITY, INDIANA U.S.A.

INSULATING VARNISHES SAVE EQUIPMENT WEIGHT

▲ As much as 50 per cent reduction in weight of electric equipment is possible where design limitations are based on insulating temperature by using the new Silicone insulating varnishes. These high temperature insulations also make possible a substantial increase in the output of small motors using the same frame, where the operating temperature can be raised. They offer the additional advantages of abi.ity to operate at higher ambient temperature, and to greatly increase life when operated at present temperature conditions. Silicone resins, and their use as insulating varnishes and bonds, definitely fill the void between organic and inorganic insulating materials.

There has long been a demand for high temperature insulation having better thermal stability. Recently developed Silicone resins and varnishes have tremendously better thermal endurance than any of the known resins and varnishes. New high temperature insulations have been developed utilizing these materials. As a result, it is possible to produce electrical equipment that has a much greater thermal endurance, as high as twenty to one on laboratory tests.



Though the motor on the left is twice as large as the one on the right, both produce 10 hp at 1750 rpm. Higher operating temperature makes this possible. The left hand motor is made with class A insulation and operates at 105 C total hot-spot temperature while the right hand motor is made with high temperature Silicone. The left hand motor weighs 410 lb and the right hand motor weighs 210 lb.

The Silicone materials bridge the gap between conventional organic insulating materials, which are limited with respect to heat stability, and ceramic type materials, which are not

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JET PIPE PRINCIPLE

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ASKANIA REGULATOR CO.

1603 S. MICHIGAN AVENUE, CHICAGO

limited with respect to heat stability. Physically, they are quite similar to conventional resins, varnishes, and organic structures, but differ in that they do not readily decompose at temperatures of the order of 200 C. In actual use, the conventional insulating structures have been modified to incorporate Silicone resins throughout. This results in an integrated line of insulating materials which will withstand abnormally severe operating temperatures.

Over two years experience on actual equipment confirms extensive laboratory tests which showed these materials to be promising. Where temperature, or size and weight as determined by temperature, are important factors in electrical equipment design, the problem should be examined in the light of these recently developed insulating materials. Silicone insulations should not be considered a panacea for all insulating ills, but instead, should be applied to specific applications where its use is justified.

MANUFACTURER ACQUIRES STEEL CASTING COMPANY

▲ H. K. Porter Company, Inc., of Pittsburgh, Pennsylvania, recently announced the purchase of Fort Pitt Steel Casting Company, of McKeesport, Pennsylvania, manufacturers of pressure and alloy steel castings.

Founded in 1906, Fort Pitt is one of the largest single units in the country producing electric steel castings, having a capacity of 1500 tons per month. It has made a specialty of high-test alloy steel products.

Since the outbreak of the present war, the company has three times been awarded the Maritime Commission pennant for outstanding production, including the first such award made to an electric foundry in the nation.

T. M. Evans, president of Porter, stated that the present policies and management of Fort Pitt would continue the same as in the past under the able leadership of Fred Grotts, president.

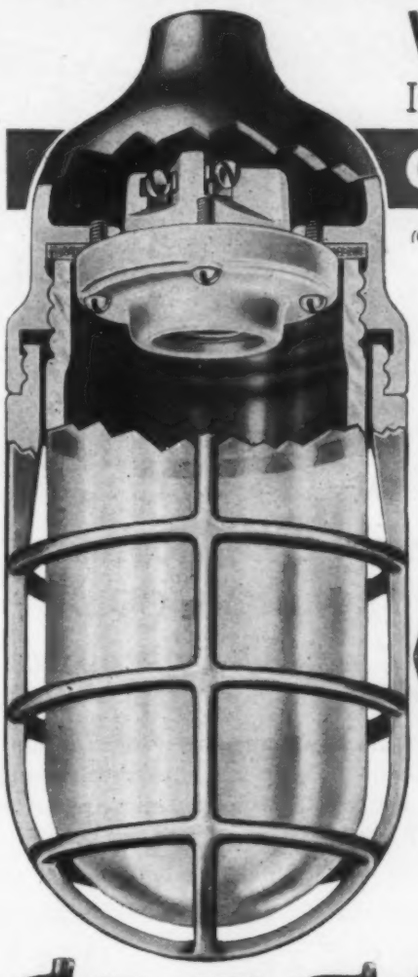
The acquisition of Fort Pitt brings to six the number of complete industrial plants operated by Porter in the manufacture of process equipment, locomotives, freight cars, pumps, and ordnance material.

PORTABLE GREASE GUN GIVES RAPID, POSITIVE HIGH PRESSURE LUBRICATION

▲ A new Alemite electric portable power grease gun, model 7190, the latest addition to the Alemite line of industrial equipment, is announced by the industrial Alemite division, Stewart-Warner Corporation.

The new gun has been developed to deliver fast, positive high pressure lubrication with all types of lubricants that seek their own level. Equipped with large heavy duty wheels for easy mobility, operation is further facilitated by means of a ball bearing front caster in the steering mechanism.

A quiet driving device connects the heavy duty 1/3 horsepower electric motor to a high pressure grease piston and cylinder, made of specially treated and hardened steel, and fitted to close limits to prevent bypassing. A mercury switch automatically shuts off the motor when

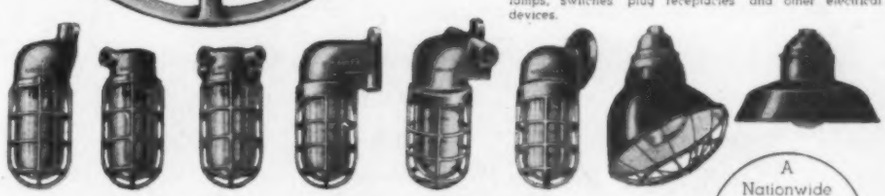


Vaportight
Industrial Lighting
CONDULETS
(CONDULETS are manufactured only by CROUSE-HINDS)

For boiler rooms, shower rooms, powerhouses tunnels, docks, building entrances, and all indoor or outdoor locations where exposed to vapors, moisture rain, smoke or non-explosive dust and gas.

Vaportight and raintight.
Wiring chamber remains vaportight even though globe is off.
Screw guard or clamp guard types.
12 Hub arrangements.
4 Reflector styles.
Accessories: colored globes, guards, half shades, adapters.
4 Sizes: 50 through 500-Watt.

Other *Vaportight* lighting fixtures are available for attachment to many round-base Condulets and sheet steel outlet boxes. Crouse-Hinds complete *Vaportight* line includes hand lamps, switches, plug receptacles and other electrical devices.



A Nationwide Distribution Through Electrical Wholesalers

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5000 pounds of pressure have been built up in the delivery hose.

The gun has an easily accessible check valve and pressure release valve. Equipment includes a 12-foot electric cord, a six foot, one-quarter inch, 20,000 pound burst pressure hose and control valve with hydraulic coupling, combination handle, cord and hose rack. The gun stands 28½ inches high, 15 inches wide and 26 inches long.

TRAINING COURSE IN ELECTRONICS AVAILABLE

▲ Designed to give in a clear, understandable manner the basic principles and applications of electronics in industry, a new ten-part training course covered by sound slide films, lesson books, quiz books, and an instructor's manual has been prepared by Westinghouse.

Although designed primarily for Westinghouse employes, the material has been made available to others at reproduction costs because of many requests from engineering groups and individuals interested in electronics.

It is recommended that twenty hours should be allowed for the full ten-part course — two hours for each part, with classes held one night each week, thus giving class members a chance for review and supplemental reading.

Subjects covered by the course are as follows:

Part I — Electronics and the electron theory of matter; electron movement during current flow through metal conductors; emission of electrons and their controlled flow through vacuum and gases.

Part II — Theory of current rectification by vacuum tubes; kenotrons — high-voltage, low-current rectifiers.

Part III — How gas in a tube neutralizes space charge; gaseous rectifier tubes.

Part IV — Electronic amplification.

Part V — Electronic generation of high-frequency alternating currents.

Part VI — Electronic oscillators for radio and carrier current transmission.

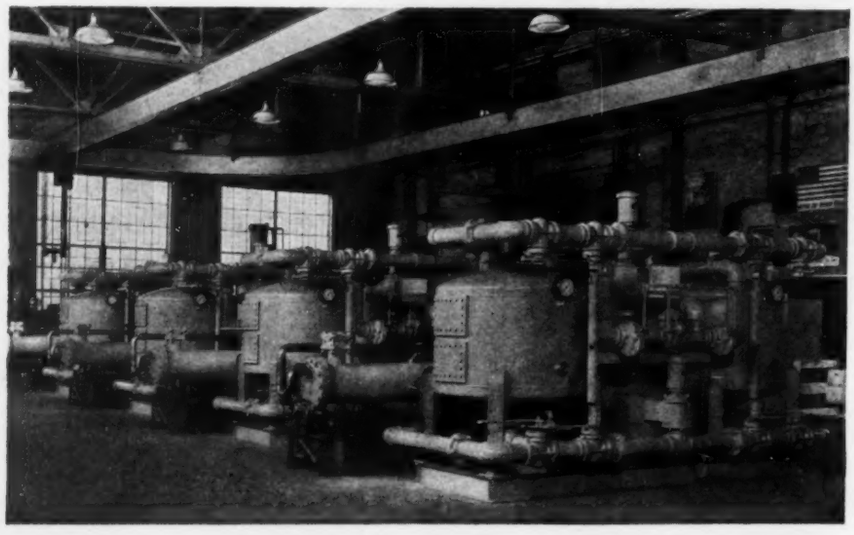
Part VII — Basic circuits for electronic control.

Part VIII — Industrial applications of electronic regulation.

Part IX — Industrial applications of electronic control.

Part X — Electronic conversion of light into electricity and electricity into light.

Sound slide films and records (for use with standard sound slide film equipment) for the ten lessons give clear, visual explanations of basic theory and applications. Ten lesson books in handy pocket size, reproducing the subject matter of each lesson, are provided for each member of the class. These afford a convenient means of review and supplemental study. Pictorial quiz books are supplied for mid-course and final review of the subjects covered, and an instructor's manual giving suggested classroom procedure is provided with the complete course. Informative booklets on industrial electronic equipment are supplied covering ignitron rectifiers, high-frequency heating, resistance welding, power line carrier, rototrol, sealed ignitron, and electronic tube data sheets.



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For improved operation, lower costs and better products or applications, investigate the processing advantages of **dryness**.

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Ask for Bulletin 25-C

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WHENEVER
ANYONE SHUTS OFF AIR SUPPLY

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WHENEVER
FUEL OR AIR PRESSURE FAILS

●

WHENEVER POWER FAILS

★

ONCE CLOSED THE VALVE MUST BE RESET MANUALLY, GIVING THE OPERATOR TIME TO CHECK THE TROUBLE AND PREPARE FOR PROPER RELIGHTING OF BURNERS

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SIMPLE COMPACT DESIGN GUARANTEES DEPENDABLE OPERATION

THE NORTH AMERICAN MANUFACTURING COMPANY

MANUFACTURERS OF INDUSTRIAL FUEL BURNING EQUIPMENT FOR GAS OR OIL

BRANCH OFFICES *with* FIELD ENGINEERS *in* PRINCIPAL CITIES

CLEVELAND 4, OHIO

SMALL PRESSES PERFORM WIDE RANGE OF WORK

▲ All steel construction throughout and simple hydraulic control is the outstanding feature of the new motorized 10 and 20 ton presses manufactured by Reimuller Brothers Company, Franklin Park, Illinois.

The Hy-speed motorized press was created because of the demand for a popularly priced unit that could be used for production line work of marking, forming, notching, pressing, broaching, assembling, and other operations. The presses are made in two models of 10 and 20 ton with 10 per cent extra tonnage available.

A hand lever hydraulic valve controls the ram movement through feed, hold or return position.

Other features pertaining to the press are: hollow large area ram for holding punches and other fixtures, lapped ram, packless design, twin pressure gauges showing pressure and tons. Stroke of ram is 12 in.

The motor driven hydraulic pump furnishes one and three-quarters gallons of oil per minute to the ram giving 1.5 in. per sec ram speed in the 10 ton and .8 in. per sec for the 20 ton.

The 10 ton press furnishes four complete strokes per min and the 20 ton furnishes two. Unit is equipped with a 220 volt 60 cycle 3 phase motor as standard equipment. Flexible lines are used throughout simplifying setting up.

LOW LIFT TRUCKS USED IN WIRE PRODUCTION

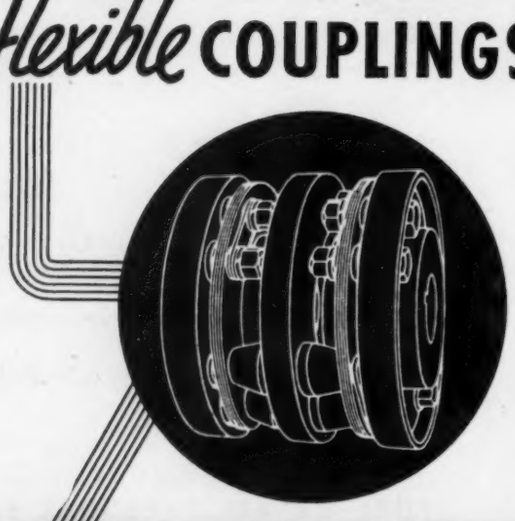
▲ The Wilbur B. Driver Company, Newark, New Jersey, manufacturers of high alloy special resistance wire for aircraft and radio equipment and welding rods used on battleships and tanks, use a Baker type E5 10,000 lb capacity Low-lift truck for servicing production machines.

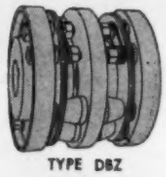
The various kinds of metals are received by railroad and highway trucks and are moved by the Baker truck into the foundry where they are melted and poured into ingot molds. The ingots are piled upon skids and then taken either to the storage yard or to the re-heating furnaces where they are prepared for rolling into bars 2½ in. square.

These bars are cut into billets which have the surface ground to remove any defects. After this operation has been completed the ground billets are replaced upon skids and removed either to storage or to other re-heating furnaces where they are prepared for rolling into strips or round stock. The strips and round wire are processed and drawn into various forms of extremely fine wire — some of which is as fine as .0015 inch.

The weight per trip varies between 3000 and 10,000 lb and the truck travels over a distance of from 100 to 500 feet depending upon the operation to be performed. In the course of a week's time the Baker E5 Low-lift truck moves hundreds of tons of skidded metals. Previous to the purchase of the Baker truck this work was done by hand which required as many as seven men to move this material with hand lift trucks. Many of these men were called off production to help move the loaded skids and the purchase of the Baker truck permitted this company to release these men for actual production work at all times — aiding in the prosecution of the war effort in this plant.

THOMAS
Flexible COUPLINGS

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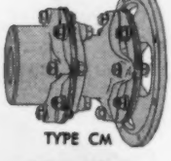
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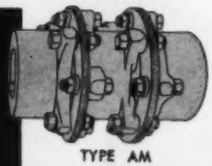
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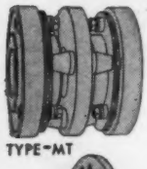
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Eliminate BACKLASH, FRICTION, WEAR AND CROSS-PULL
the four destructive evils of other types and makes of couplings that prevent a permanent care-free installation.

The Thomas All-Metal Coupling has:
No Chains, No Gears, No Rubber.
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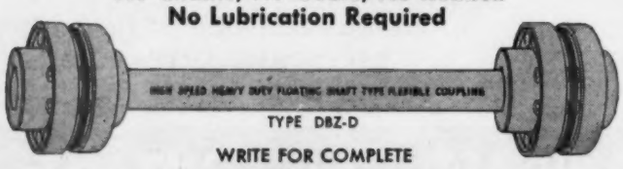
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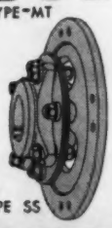
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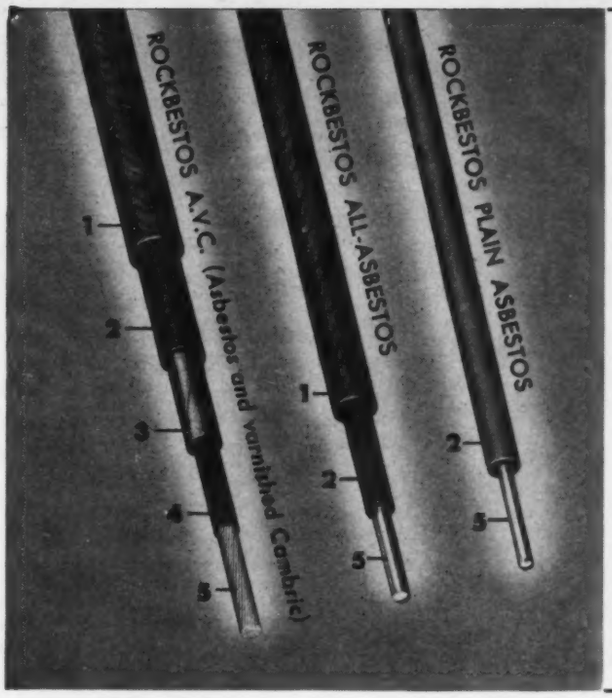
THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA



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Rockbestos Permanent Insulation Insures Long-Lived Performance

1. A tough, rugged asbestos braid, resistant to heat, flame, moisture, oil, grease and corrosive fumes.
2. Felted asbestos insulation impregnated with heat-, flame-, and moisture-resisting compounds will not dry out, become hard and brittle, or burn. Also serves as a heat-barrier against high ambient temperatures.
3. Lubricated varnished cambric for high-dielectric strength and added moisture resistance, protected from heat, flame, and oxidation by felted asbestos walls.
4. Felted asbestos insulation that withstands conductor-heating overloads and won't burn even when exposed to copper-melting arcs.
5. The conductor is perfectly centered in helically applied insulation and will always remain so.

600 VOLT A.V.C. SWITCHBOARD WIRE—TABLE B

(Underwriters' Type AVB)

Sizes No. 18 to 4/0 A. W. G. with varnished cambric and felted asbestos insulation and gray, black, white or colored flameproof cotton braid.

Combine fire insurance and fine appearance in your switchboards with Rockbestos Switchboard Wire. It is absolutely fireproof and will not dry out under heat. Sharp, clean bends can be made without cracking as the asbestos wall acts as a cushion under the braid. Rockbestos A. V. C. Hinge Cable and Switchboard Bus Cable have the same fireproof and heatproof characteristics.

INDUSTRIAL HEATING CABLE—TABLE LH

No. 19 A. W. G. nickel-chromium wire insulated with .040" of felted asbestos and covered with 4/64" waterproof lead sheath.

This pliable cable distributes a mild heat evenly over a large area. Prevents freezing of water pipes, wet pipe sprinkler systems, etc. Keeps conveyor pipes for fuel oil, soap, varnish, ink, chocolate, etc., at temperatures that insure steady flow.

ASBESTOS INSULATED MAGNET WIRE

Round, square and rectangular asbestos insulated conductors finished to meet varying winding conditions and coil treatment requirements.

Protect your motors against heat-induced breakdowns with class B windings of Rockbestos Heat-Resisting Magnet Wire. Leads of A. V. C. Motor Lead Cable will complete the failure-proofing.

ALL-ASBESTOS FLEXIBLE CORD—TABLE CA

Sizes No. 10 to 18 A. W. G. with two or three conductors insulated with felted asbestos, covered with asbestos braid. Also in A. V. C. (asbestos and varnished cambric) constructions.

This heat-resisting flexible cord is ideal for high-wattage lighting units, floodlights, blueprint machines, apparatus, etc., which require a heavy duty, enduring cord. For moisture-resistant construction specify the A. V. C. type. Labeled cord with polarized conductors if desired.

600 VOLT A.V.C. BOILER ROOM WIRE—TABLE C

(Underwriters' Type AVA)

Sizes No. 18 to 4/0 A. W. G. This construction for sizes 18 to 8, sizes 6 to 4/0 have another wall of felted asbestos next to the conductor.

For lighting and control circuits exposed to heat and moisture, oil, grease, corrosive fumes or fire hazard, such as exist around furnaces, ovens, lehrs, soaking pits, boilers, etc., this widely used A. V. C. construction is ideal. Also for locomotive panel wiring and for switchboards requiring an asbestos braided wire.

THERMOSTAT CONTROL WIRE—TABLE TC

Sizes No. 14, 16 and 18 A. W. G. in two to six conductors with 12½, 25 or 31 mil wall of felted asbestos insulation and cadmium plated steel armor.

A multi-conductor control wire for low voltage intercommunicating, signal and temperature control systems. Its lifetime insulation and rugged steel armor will give you trouble-proof circuits.

600 VOLT ALL-ASBESTOS RHEOSTAT CABLE—TABLE R

(Underwriters' Type AI)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with a heavy wall of felted asbestos, covered with a rugged asbestos braid finished in black, white or colors.

Use this power and rheostat cable for wiring rheostats, switchboards, elevator and locomotive control panels and electrical equipment exposed to heat, fumes and fire hazard. Also for general open wiring in dry, high temperature locations. For solid conductor specify Rockbestos Rheostat Wire, Table A.

600 VOLT A.V.C. MOTOR LEAD CABLE—TABLE L

(Underwriters' Type AVA)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with two walls of felted asbestos and a high-dielectric, heat-sealed varnished cambric insert, covered with heavy asbestos braid.

Heatproof, fireproof, greaseproof and oilproof, will not dry out and crack, won't burn or carry flame, and remains permanently flexible. For coil connections, motor and transformer leads where extreme heat and fire hazards are encountered as in steel mills, etc.

600 VOLT A.V.C. CONTROL CABLE

In one to 19 conductors. Standard stranding A. W. G. No. 18—19/No. 25 and No. 9—19/No. 22. Other strandings furnished.

Designed for use under conditions too severe for control cables with other types of insulation which deteriorate rapidly when exposed to high temperatures. Operates without failure under the attack of heat, oil, grease or corrosive fumes and may be installed in conduit as it has ample moisture resistance.

600 VOLT A.V.C. POWER CABLE—TABLE E

(Underwriters' Type AVA)

Sizes No. 18 A. W. G. to 1,000,000 CM insulated with laminated felted asbestos, varnished cambric, and asbestos braid. Other constructions for service voltages to 8000.

Recommended for power circuits and hot spot wiring in or around boiler rooms, steam tunnels, soaking pits, tenter frames, glass plants, etc. The asbestos and heat-sealed varnished cambric construction has ample moisture resistance and withstands high temperatures.

Rockbestos Products Corporation, 957 Nicoll Street, New Haven, Conn.

WON'T bake brittle, bloom, burn or rot—RESISTS heat, moisture, oil, grease and fumes

ROCKBESTOS

The Wire with Permanent Insulation

New Literature

▲ William M. Bailey Company, Pittsburgh, Pennsylvania, has published a new bulletin on the Bailey Junior Pug Mill. With a capacity of 5 to 15 tons per hour, these units are adapted for conditioning fine dust from secondary dust catchers and centrifugal dust collectors and for mixing and moistening granular materials of any kind. This bulletin is available upon request.

▲ To acquaint industry with equipment that will aid in the efficient, safe and convenient handling, storage and dispensing of liquids while conserving and accurately measuring them, Bowser, Inc., Fort Wayne, Indiana, has assembled a booklet setting forth some of the methods recommended. One or more of the units of equipment described should find application in any plant confronted with this problem. This bulletin, "Liquid Storage, Handling and Dispensing Equipment for Industry," is available upon request.

▲ A new standard line of steel plate vertical punches is announced by Thomas Machine Manufacturing Company, Pittsburgh, Pennsylvania, in its just-issued bulletin No. 303 entitled "Vertical Punches." Electrically welded, these machines are lighter, stronger in frame, and offered at considerably lower cost than the cast frame type. Thomas' line of heavier cast frame punches is also fully illustrated in bulletin 303, with close-ups of floating punches, gagged punching units, shearing attachments, and special tool set-ups being shown. Also given are tables of punching pressure and machine capacity.

▲ "Evaluating The Forgeability of Steels," latest publication of The Timken Roller Bearing Company's Steel and Tube Division, is an 8½ in. x 11 in., 78-page book, containing for the first time recommended forging temperatures of sixty-eight steels, as determined by the hot twist test conducted in The Timken Roller Bearing Company laboratories, under the supervision of C. L. Clark, Timken research metallurgical engineer. The apparatus and procedures used are described and the results of tests on various steels interpreted. A free copy of the book may be obtained from the Steel and Tube Division, Timken Roller Bearing Company, Canton, Ohio, by writing on your letterhead.

▲ Anyone who needs a portable instrument to measure temperatures of glowing objects will be interested in the 16-page catalog, "Optical Pyrometer" (Potentiometer Type), recently reprinted with minor changes by the Leeds and Northrup Company, Philadelphia, Pennsylvania.

The potentiometer-type instrument described is at once precise, dependable and convenient. It is compact, lightweight and provides readings directly in degrees. It is said to be so easy to use that even an inexperienced operator can make readings with precision — simply by sighting the telescope on the hot surface, adjusting two knobs, and reading a temperature scale. Any measurement can be made in a few seconds. For more complete information, write for Catalog N-33D.

▲ In an attractive 82 page book for private distribution, the Koppers Company, Pittsburgh, Pennsylvania, has presented a brief history of the development of the by-product coke oven, with a summary of the latest methods of coking. The book is well illustrated with drawings and photographs of early types of ovens as well as modern designs. A number of auxiliary items of coke oven equipment are described in the appendix to the book.

▲ Safe, steel-clad switchgear, known as Multumite, with air circuit breakers for service up to 600 volts a-c or 250 volts d-c, is described in catalog 6002, obtainable from the I-T-E Circuit Breaker Company, Philadelphia, Pennsylvania. This indexed catalog describes and illustrates important construction features such as supporting structure, panels, doors, buses, fittings, and finish. Included are dimensions, conduit locations and approximate weights of both drawout and stationary elements well as as a diagram of standard symbols commonly used in switchgear drawings.

A section on drawout mechanisms pictures pantograph supports for circuit breakers up to 1600 amperes and floor mounted trucks for larger capacities. Interlocks, and disconnecting devices for main circuits and small wiring, are also illustrated.

▲ Three processes which are applied to iron and steel to prevent corrosion at high temperatures are described in a new folder (Bulletin 45) recently published by Metallizing Engineering Company, Inc., Long Island, New York. Known as Metcolizing, these processes will increase service life of ordinary iron and steel heat treating equipment from 200 to 800 per cent. The processes are easy to apply and lend themselves particularly well to shop production methods.

▲ Wheelco Instruments Company, Chicago, Illinois, has issued three new bulletins describing new and improved products. Bulletin J602-2 describes the new Throttltrol, a simplified valve positioning device to be used in conjunction with any control instrument having a high and low contact with a neutral position. Bulletins J403-2 and J402-2 cover the new automatic and manual Inputrols, which are simplified electrical timing devices which maintain desired input of electrical power, heat or flow of liquid or gases, when employed with any automatic control instrument having a high and low contact with a neutral position. The improved Rheotrol, another device to maintain a desired electric power or heat input or flow of liquids or gases to any process or equipment, is described in bulletin J303-2.

▲ A new bulletin just published describes the method of super-speed piercing of sheet metal through templates by the Wiedemann R-44 turret punch press.

Described fully is the principle that cuts production time from hours to minutes by eliminating the time usually required to drill hole positions and then open them up to correct size and shape, by piercing more openings per minute than by any other method of piercing through templates, and by minimizing handling time while the material is in the template on the press.

A copy of this bulletin describing the R-44 turret punch press may be obtained from the Wiedemann Machine Company, Philadelphia, Pennsylvania.

New

SPEEDAIRE

Fan-Cooled Unit by Cleveland

More horsepower per dollar! With the new Cleveland Speedaire Worm Gear Unit it is possible to obtain an operating capacity equal to that of a standard worm gear unit having approximately double the frame size.

Speedaire — the *new* Fan-Cooled unit — continually removes heat by means of a high-velocity air stream scouring the outer surfaces of the oil reservoir, giving it a greatly-increased capacity over a standard worm gear unit.

You can see the new Speedaire Unit at "Cleveland Headquarters" at the Hotel Wm. Penn during the Annual Meeting, September 25th-27th. You are cordially invited to attend this first showing and to obtain descriptive literature.

The Cleveland Worm & Gear Company, 3278 East 80th St., Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication
In Canada: PEACOCK BROTHERS LIMITED

Cleveland SPEEDAIRE Worm Gear Reduction Units
FAN COOLED

NE ...THE INSIGNIA of Quality

In Steel Gears and Castings

NE . . . is maintaining the leadership in war-time Service of Supply which it achieved in serving a peace time Industrial Nation with Neloy and Neloy Molybdenum Steel Gears and Castings. War-time production comes first on any schedule . . . however, sufficient capacity in plant and equipment is available for producing maintenance parts important to the smooth running of Industry's heavy schedules today . . . the National Erie Corporation producing to specifications for Uncle Sam, stands ready to do its utmost to supply necessary maintenance parts for heavy machinery... Iron and Steel Engineers can depend upon our earnest efforts to serve them as promptly as possible for the Duration.

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ERIE, PENNSYLVANIA • U. S. A.

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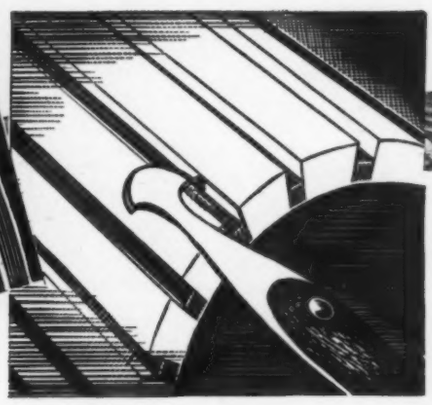
NE

The A B C of Good Commutation and Electrical Machine Performance

● Serious shutdowns and consequent delays in the production and delivery of urgently needed materials can be avoided by observing these simple precautions in the maintenance of motors, generators and converters. Under present conditions, dependable and uninterrupted performance of electrical power equipment is of utmost importance. Keep your machines in readiness to deliver full output at all times.



Keep Commutators and Rings Clean

Cleanliness is of paramount importance in the continuous operation of brush-using equipment. Time spent on keeping commutators, rings, brush holders and rigging free from dust, dirt, oil and film pays dividends. Use a suitable canvas wiper frequently on commutators and rings. Keep them clean and keep them running.

Keep Undercut Commutators Free from Side Mica

Thin edges of mica along the sides of slots of undercut commutators are a frequent source of trouble. Special care should be taken to inspect each slot carefully and to remove all side mica when undercutting commutators. Bad sparking and serious commutator burning can be avoided by observing this precaution.

Keep Brush Pressure Uniform and Correct

The spring pressure applied to brushes has a marked influence on brush performance. Equal distribution of current among all brushes requires that the pressure on all brushes be kept as nearly equal as possible. Check brush pressure frequently and adjust it to compensate for brush wear. Use pressures recommended for the grade of brush and class of service in which it is used.

MODERN PYRAMIDS will tell you more

This series of bulletins contains practical information on Commutation, Brush Operation and Machine Maintenance to help conserve present equipment and to keep it in continuous and efficient operation. If you are not receiving these bulletins write us direct or contact your National Carbon representative.

The services of our engineering staff are available for the proper selection and application of "National" Carbon Brushes on all types of equipment and for every class of service.

Keep your eye on the infantry . . . the doughboy does it!

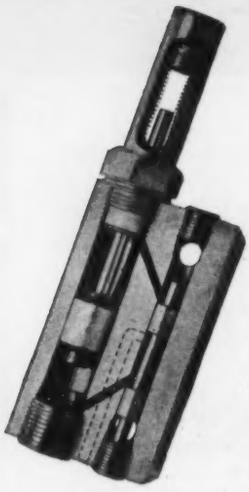
NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide and Carbon Corporation

UCC

GENERAL OFFICES: 30 East 42nd Street, New York 17, N. Y.

DIVISION SALES OFFICES: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco



Farval alone gives you all of these vital features:

- contains no springs
- has but two moving parts
- contains no check valves
- is individually adjustable
- contains no small ports
- will distribute either oil or grease
- measures by piston displacement
- with a tell-tale indicator at every bearing

The extreme simplicity of the Farval Lubricant Measuring Valve is the result of 18 years of experience in its application to all types of equipment. One by one throughout the years the objectionable features of springs, check valves, multiple parts and restricted ports have been eliminated from its simple construction.

The hydraulic, pressure-operated Farval Valve, with but two moving parts, is considered to be the finest development in the field of Centralized Lubrication.

The Farval Corporation, Cleveland 4, Ohio.

Affiliate of The Cleveland Worm & Gear Company
Industrial Worm Gearing
In Canada: PEACOCK BROTHERS LIMITED

FARVAL
CENTRALIZED SYSTEMS OF LUBRICATION

There are more Farval Systems installed on steel mill equipment than all other makes combined

Personnel News

William W. Knight, Jr., who has been in the sales office of the Morgan Construction Company, Pittsburgh, Pennsylvania, for the past eight years, has been transferred to the home office in Worcester, Massachusetts, where he is connected with the engineering staff of the rolling mill department.

W. W. KNIGHT, JR.

R. F. Horn, divisional superintendent for Republic Steel Corporation in their central district, has been placed in charge of the blast furnace and coke plant, steel plant and stainless division at Massillon, Ohio, and the South sheet division and the Stark sheet division, at Canton, Ohio. Mr. Horn was born in Dover, Ohio, and attended school at Hamilton, Ontario. He has been in the steel business for thirty-two years and came to Republic in 1931 as superintendent of the Stark division. In 1940 he was also placed in charge of the South sheet division and the following year of the Massillon armor plate division.

O. A. Bamberger, formerly superintendent of the mechanical department at the Massillon plant of Republic Steel Corporation has been made superintendent of the Massillon steel division. He received his early education in Massillon where he was born and in 1918 began working for Central Steel Company, a predecessor company of Republic. In 1921 he was transferred to the Metallurgical department and from 1926 to 1940 had charge of special experiments in metallurgical and application work for maintenance. Between October 1st, 1940, and April 2nd, 1941, he was associated with the Armor Plate Plant at Massillon, and in 1941 was made superintendent of the Mechanical division.

Roland Millar succeeds **Mr. Bamberger** as mechanical superintendent for the Massillon plant of Republic Steel Corporation. Mr. Millar was born in Youngstown, Ohio, and went to school at Kiski Preparatory School, Saltsburg, Pennsylvania. In 1915 he joined the Massillon Rolling Mill Company as a crane operator, and later went with the Central Steel Company and in 1926 became a field engineer with the Central Alloy Company. In 1931-32 he was a mechanical designer in Russia. In 1933 he was made maintenance engineer for Republic, four years later a general mechanical foreman, and in 1941 assistant superintendent of the Mechanical department.

O. A. BAMBERGER

Eugene B. Mapel has been appointed supervisor of administration planning for Carnegie-Illinois Steel Corporation, a United States Steel subsidiary, succeeding **George A. Whitehurst,** resigned. Mr. Mapel will assume the responsibility of coordinating policy and procedure throughout the company.

In 1936 Mr. Mapel began his service with Carnegie-Illinois at the company's Gary Sheet and Tin Mill where three years later he was made director of training. He was transferred in 1940 to the Pittsburgh general office as assistant to the chief of training, industrial relations department. In June, 1943, he was named manager of personnel and training division of the sales department, the position he held until his present appointment.

C. P. Houghton succeeds **Mr. Millar** as assistant superintendent of the mechanical department. He has been with Republic Steel Corporation and its predecessor companies since 1921, starting in the machine shop of the Central Steel Company. Since 1932 he has been mechanical foreman of the Enduro Division. He was born in Mingo Junction, Ohio, and attended Washington High School at Massillon.

H. E. McGoff, formerly with Hyatt Bearings Division, General Motors Corporation, is now associated with Harris Pump and Supply Company as manager of their Bearing division. This division stocks and supplies with complete engineering service, bearings of all types, and represents the majority of the leading bearing manufacturers. Mr. McGoff, after graduation from Northeastern University in 1929, entered the Hyatt organization

at their Harrison, New Jersey plant and in 1935 was transferred to their Pittsburgh office.

R. G. Wingerter, for the past six years an industrial engineer for The Timken Roller Bearing Company has been appointed assistant chief engineer for the Industrial Division, according to an announcement made by the Canton, Ohio, firm. Wingerter is an honor graduate of Wayne University and holds a bachelor of science degree in mechanical engineering.

EDGAR C. BRANDT

Edgar C. Brandt has been made assistant to the general manager of the Crocker-Wheeler Electric Manufacturing Company, Division of Joshua Hendy Iron Works. Prior to his connection with Crocker-Wheeler, Mr. Brandt was associated with the Elliott Company as vice-president and general manager, and with the Westinghouse Electric and Manufacturing Company in East Pittsburgh, Pennsylvania.

Theodore J. Kauffeld has been made vice-president and director of Devenco, Incorporated, New York, New York, a new organization set up to render specialized engineering services as well as regular consulting work. From 1926 to 1936 Mr. Kauffeld was connected with De Laval Separator Company, working with lubrication, descaling and roll cooling problems, and developing much of the equipment applied to the continuous strip mills. From 1936 to 1939 he was located in London, England, engaged in consulting engineering work.

Arthur H. Soper has been appointed field representative for the Trumbull Electric Manufacturing Company of Plainville, Connecticut, assisting the district manager, **Frank M. Oglee.** Soper's early home was in Connecticut where he was employed in the service inspection department of the Hartford Electric Light Company. In 1925 he joined the Electrical Division of the Colt Patent Fire Arms Company as their Connecticut representative and a year later was transferred to the Philadelphia territory as manager, until Colt's Electrical Division was sold.

F. B. Hufnagel has resigned as chairman and president of Crucible Steel Company of America, but will continue as a director and will serve also in an executive advisory capacity to the company's management. Mr. Hufnagel has been associated with the Crucible Steel Company of America for more than twenty-four years. He begame president of the Pittsburgh Crucible Steel Company, a principal subsidiary in 1920 and in 1926 became president of the parent company. For the last seven years he has been chairman of the company. During most of this time he has also served as president.

W. P. Snyder, Jr., who succeeds **Mr. Hufnagel** as chairman, has been a director of Crucible Steel Company of America since 1930 and chairman of its executive committee since July, 1942. He has been actively engaged in the iron and steel industry for more than thirty years. After graduation in 1910 from the Sheffield Scientific School of Yale University, Mr. Snyder entered into the employment of The Shenango Furnace Company and W. P. Snyder and Company, of which his father, the late W. P. Snyder, was head. As president of The Shenango Furnace Company, Mr. Snyder has been identified mainly during the last twenty years in the production of iron ore, pig iron, ingot molds, and with Great Lakes shipping. He is president of the Snyder Mining Company. a corporation owned by Shenango Furnace Company and Crucible Steel Company of America, which furnishes from its Minnesota mines practically all of Crucible's iron ore requirements.

N·B·M BRONZE AND COPPER CASTINGS

Blast Furnace Copper Castings • Roll Neck Bearings • Housing Nuts • Machinery Castings • Acid Resisting Castings • Phosphorized Copper • Locomotive and Car Journal Bearings • Babbitt Metals

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ST. LOUIS • PITTSBURGH • NEW YORK

ELECTRIC
DOOR LIFTS
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DOOR LIFTS FOR
Furnaces · Ovens · Industrial Buildings
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Furnaces · Ovens · Cars · Mixers
NEW PRINCIPLES OF DESIGN
Low in Cost · High in Efficiency
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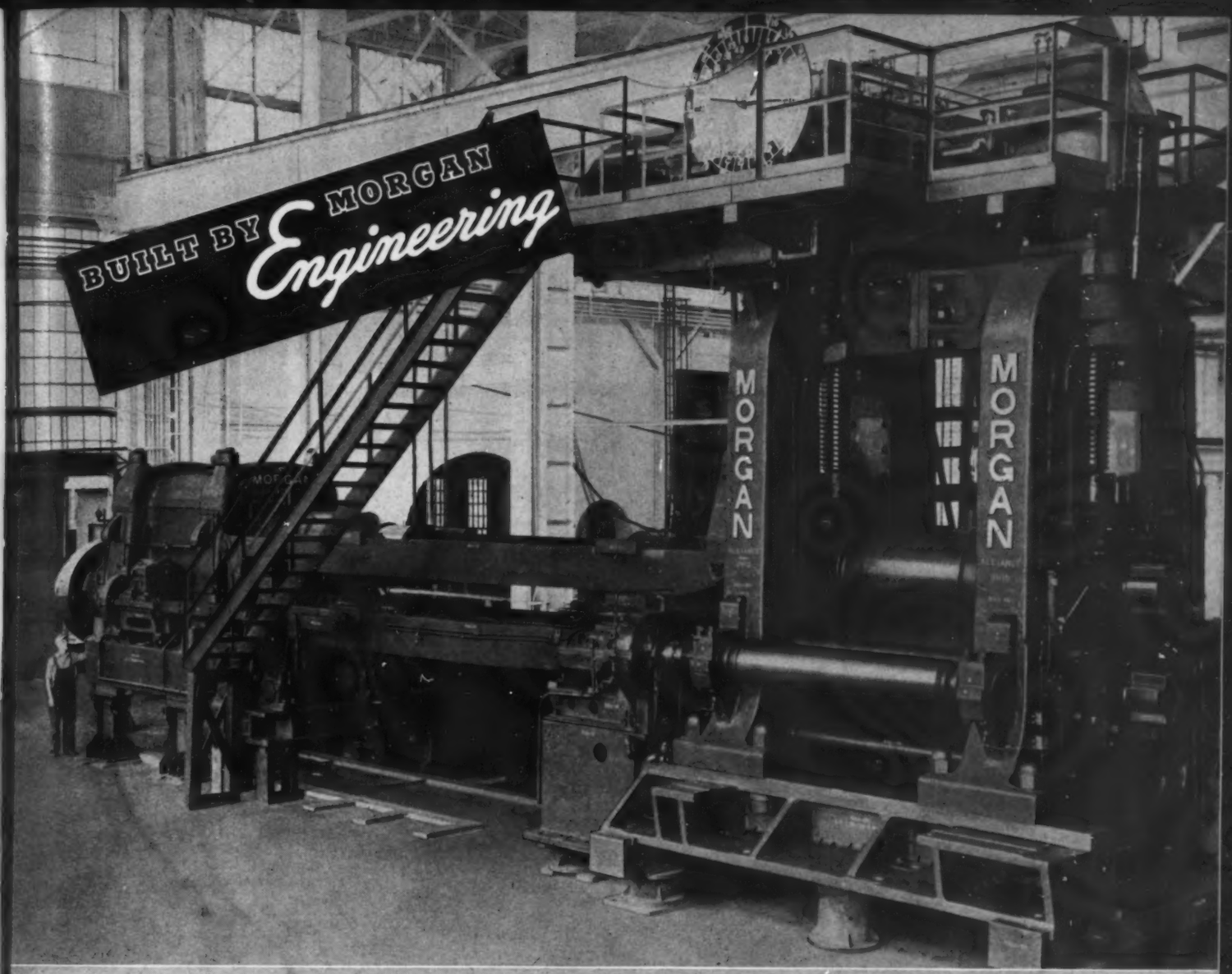


MORGAN "36" TWO-HIGH BLOOMING MILL

Above is shown a Morgan 36" Two-High Blooming Mill on erecting floor. Housings are one piece steel castings of the closed top type. Top roll balance is of the counterweight type. Top roll lift sufficient for rolling 42" wide slabs. Manipulator is of the overhead type, compact and accessible. Tables are of heavy design, equipped with anti-friction bearings.

With this Mill was furnished Auxiliary Equipment as follows — Front and Rear Tables with Manipulator — Approach Table — Ingot Buggy — Runout Tables — Slab Shear with Gauge — Crop Hoist — Pushers — Conveyor — Skid Bed and Furnace Tables.

THE MORGAN ENGINEERING CO.

ALLIANCE, OHIO. 1420 Oliver Building, Pittsburgh

DESIGNERS • MANUFACTURERS • CONTRACTORS • BLOOMING MILLS • PLATE MILLS • STRUCTURAL MILLS • ELECTRIC TRAVELING CRANES • CHARGING MACHINES • INGOT STRIPPING MACHINES • SOAKING PIT CRANES • ELECTRIC WELDED FABRICATION • LADLE CRANES • STEAM HAMMERS • STEAM HYDRAULIC FORGING PRESSES • SPECIAL MACHINERY FOR STEEL MILLS

McKAY

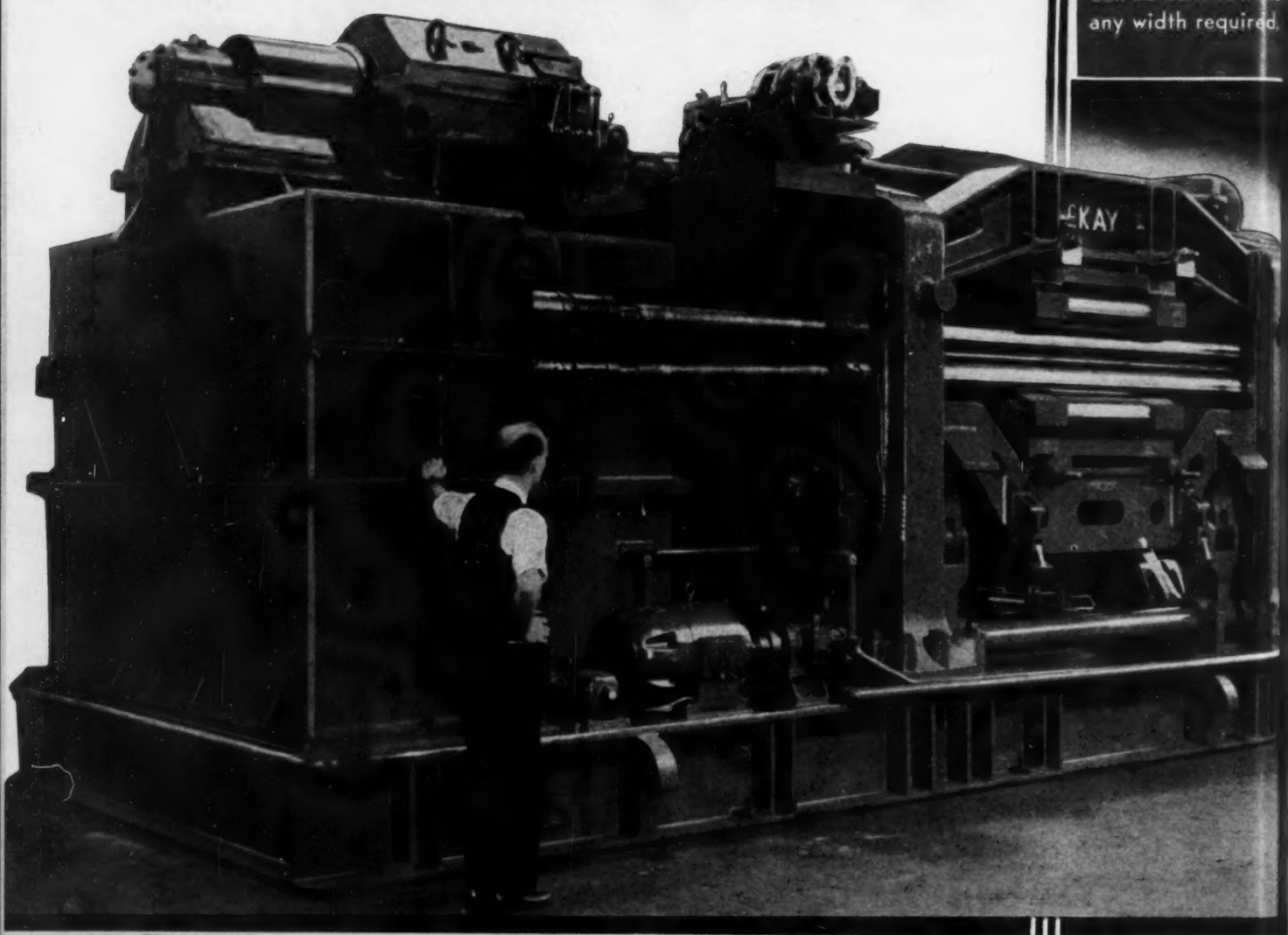
IMPROVED HEAVY DUTY ROLLER LEVELLER

MEDIUM HEAVY PLATE *in* CARBON, ALLOY *and* STAINLESS STEEL

Massively built t
accommodate th
maximum pressure r
quired to flatten hig
tensile steel.

The feed-in rolls ca
be hydraulica
opened to a maxim
of 12" to receive an
straighten ends tha
are badly bent.

This leveller will fla
ten a wide range o
thickness in plates an
can be built to hand
any width required.



The **McKAY MACHINE** *Company*

ENGINEERS AND MANUFACTURERS OF SHEET, TIN, AND STRIP MILL EQUIPMENT

YOUNGSTOWN, OHIO

ASSOCIATED COMPANY

The WEAN ENGINEERING CO., Inc. • WARREN, OHIO

A Washington Magnesite Ramming Mixture

FOR BASIC OPEN-HEARTH AND ELECTRIC STEEL FURNACES

In basic steel practice the name H-W Magnamix means the ultimate in economical service. More than a score of H-W Magnamix open-hearth bottoms are already in service and the notably successful results being attained are enthusiastically attested by the operators. The splendid reputation of H-W Magnamix for hot patching banks and flats and for repiping tap-holes is widely established in all sections of the United States. Equally successful are the results secured with H-W Magnamix in basic electric steel furnace practice.

H-W Magnamix adheres to the steepest slopes and sinters rapidly to form a durable patch. The advantages of high magnesia content and great density are reflected in the reduction of tap-hole maintenance by one-half or even two-thirds.

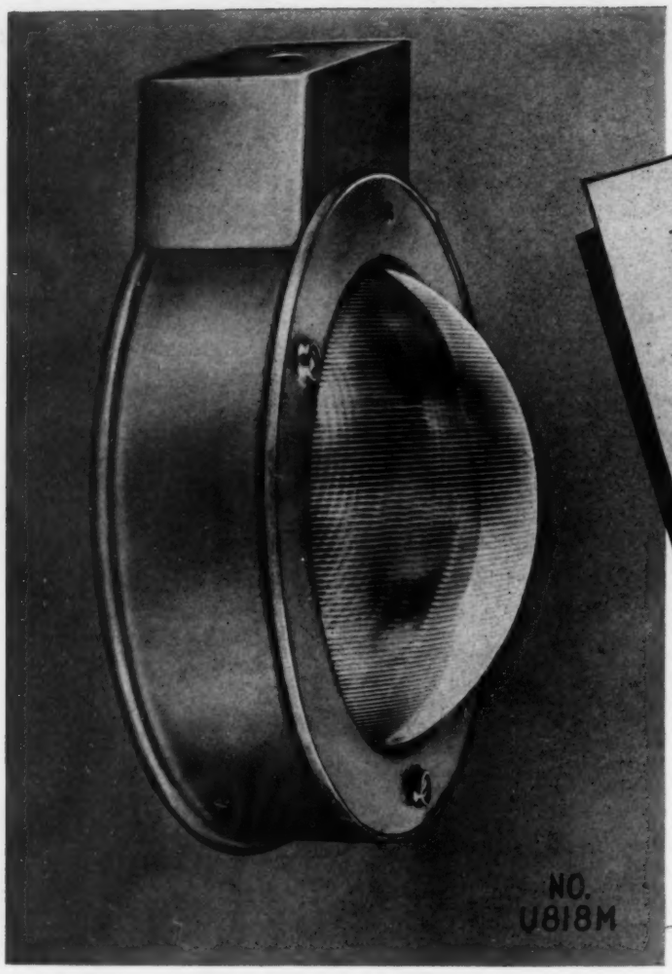
TRADE MARK

HARBISON-WALKER REFRACTORIES CO.

and Subsidiaries

REG. U.S. PAT. OFF. WORLD'S LARGEST PRODUCER OF REFRACTORIES

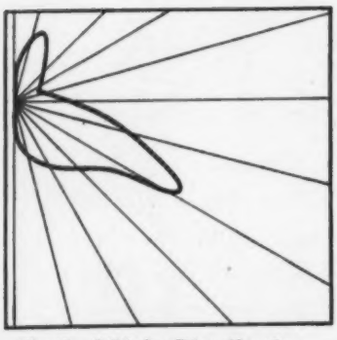
GENERAL OFFICES, PITTSBURGH 22, PENNSYLVANIA



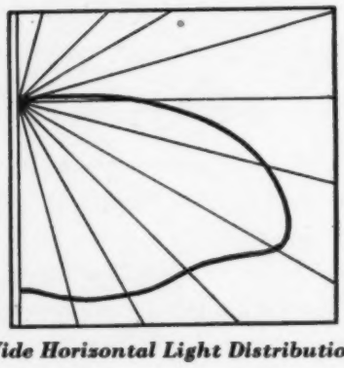
HOLOPHANE
Presents
NEW
OUTDOOR LIGHT

For

- **BLAST FURNACES**
- **LOADING PLATFORMS**
- **OUTDOOR STORAGE**
- **UNDERPASS and General EXTERIOR USE**



Vertical Light Distribution



Wide Horizontal Light Distribution

NO. U818M, product of Holophane research, is an efficient, rugged, trouble-free lighting unit, recommended for exposed and outdoor use because it is built to withstand abuse . . . Lamp size 300 watt, mogul base. Housing Cast Iron. Mounting flush in wall or exposed. Lens, double wall, smooth outside, Hi-Stress Glass. Face plate and lens hinge for speedy, convenient relamping.

Write for Engineering Data — Available Without Charge.

HOLOPHANE COMPANY, INC..... *Lighting Authorities Since 1898*

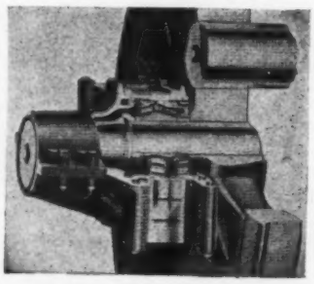
342 MADISON AVENUE, NEW YORK 17 • Holophane Co., Ltd., 385 Yonge St., Toronto, Can.

"Bridgeport"
HEAVY DUTY
Vertical
Surface Grinder
No. 103

DESIGNED FOR FAST, ACCURATE METAL REMOVAL

The technique of modern metal removal has been brought to a high state of development in "Bridgeport" machines and wheels. Their surprising performance has long since demonstrated beyond the shadow of a doubt that there is no substitute for good equipment!

Today the line is giving a glorious account of itself in the hard, unceasing grind of war's demands. "Tomorrow" it will shift smoothly over to peace production . . . proving that, war or peace, money spent for "Bridgeport" equipment is never less than a long-term investment.



GRINDING TIMKEN AXLES

Besides the standard line of "Bridgeport" grinders, special machines may be had for special needs such as that shown above.

Major Advantages of Surface Grinder No. 103

SPINDLE BEARINGS — Radial ball bearings for radial load, self-aligning, spring-cushioned thrust bearings for thrust load.

DUAL WHEEL FEED — Grinding head may be moved up and down by a hand-wheel at front of bed. Automatic down feed at each end of table stroke — so arranged that operator may raise wheel head quickly for loading then shift to the low, to give him control in bringing his wheel almost in contact with the work.

HYDRAULIC OPERATION — Table travel 120 ft. per minute. Smooth, shock-proof reversal.

QUICK STOP — Operator may stop the wheel quickly without jar or shock by use of spindle brake motor.

AUXILIARY CONTROLS — Hand reversal for instant table reverse.

PRESSURE LUBRICATION of ways and bearings with oil filter. Oil feed correctly regulated for perfect lubrication.

POWER ample for heaviest requirements, yet always under instant control from operating side of machine.

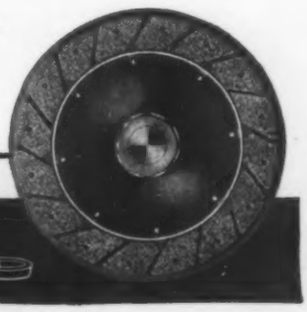
AMPLE COOLANT, properly distributed, is supplied from large reservoir.

"BRIDGEPORT" SECTIONAL GRINDING WHEEL, for maximum stock removal and fast, cool cutting. Wheel design brings coolant well into the cutting edges.

THE BRIDGEPORT SAFETY EMERY WHEEL CO., INC., BRIDGEPORT, CONN., U. S. A.

Bridgeport

GRINDERS • GRINDING WHEELS • BUFFING LATHES



FOR INCREASED TONNAGE *in the* OPEN HEARTH

Over 6,000,000 Tons of Rimming Steel were made by 30 Steel Works during the past year with the use of our SODIUM FLUORIDE PROCESS.

It provides a larger yield of product with better quality.

Our Improved Equipment and Processes Include...

VENTURI PORTS . . . SLOPING BACK WALLS . . . DANFORTH-PETERSON CHECKERWORK . . . FUEL MIXING BURNERS . . . TAPERED DOOR FRAMES . . . SODIUM FLUORIDE PROCESS FOR RIMMING STEEL . . .

Over 90 Percent **of the open hearth steel capacity use our improvements.**

Adding Sodium Fluoride to the Ingot

Open Hearth Combustion Company

GEO. L. DANFORTH, JR., Pres.

Engineers *Consultants* *Designers*

310 South Michigan Avenue Chicago, Illinois

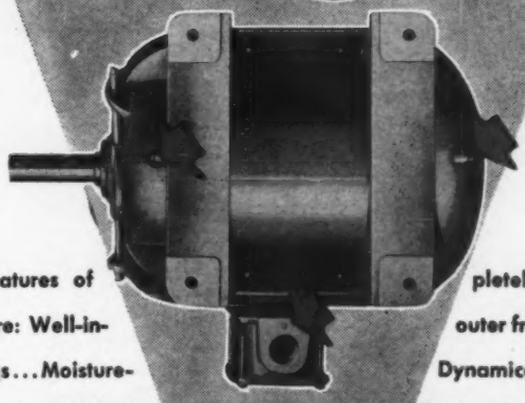
Wagner

CHEMICAL-PROOF MOTORS

RESIST THE DAMAGING ACTION OF ACIDS, FUMES, MOISTURE, AND OTHER DESTRUCTIVE ELEMENTS

Below—Moisture-proof and dust-tight conduit box—screw-on type.

Right—Special drain plugs in endplates and conduit box provide for the removing of any condensation.



Above—Nipple is solidly welded into side of motor. Flexible compound completely seals lead wire openings.

OUTSTANDING construction features of Wagner Chemical-Proof Motors are: Well-insulated and impregnated windings... Moisture-proof and dust-tight conduit box... Special drain plugs in endplates and conduit box... Totally-enclosed, fan-cooled construction—inner frame completely seals windings and bearings, while outer frame guides cooling draft over motor... Dynamically-balanced (running balance), insuring freedom from vibration... Sealed cartridge-type ball bearings.

Write for Complete Literature...

For full information on Wagner Chemical-Proof Motors consult the nearest of Wagner's 29 Branch offices, located in principal cities and manned by trained field engineers.

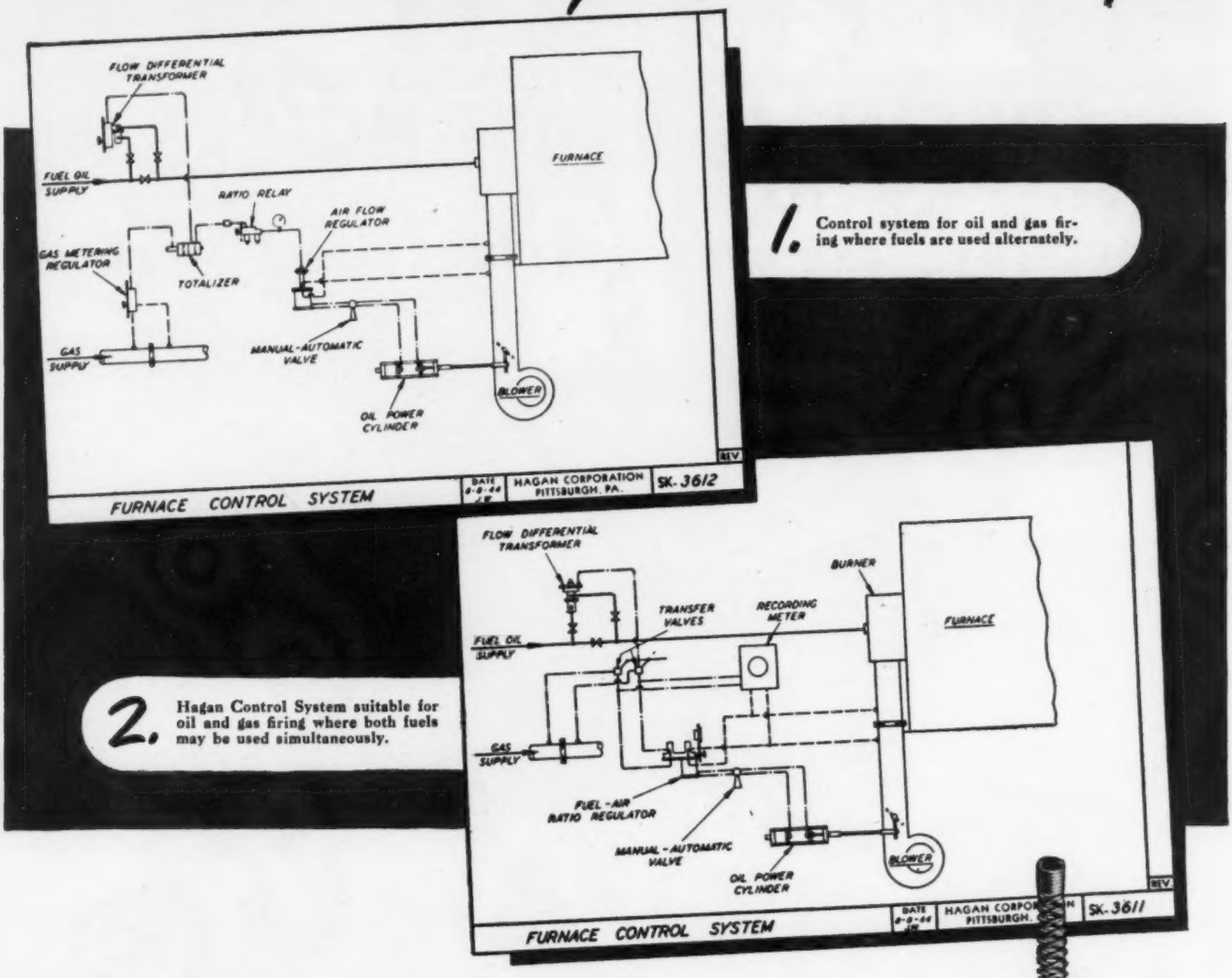
Wagner Electric Corporation
ESTABLISHED 1891
6483 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

MOTORS
TRANSFORMERS
UNIT SUBSTATIONS
INDUSTRIAL BRAKES
BRAKE LINING

M44-58

BACK THE ATTACK — BUY U.S. WAR BONDS

What about *Multiple Fuel Firing?*



IN steel plants, by-product gaseous and liquid fuels are available for use in heating steel. While storage facilities are usually available for liquid fuels, this is not the case with gas fuels which must be used when and as available.

For most economical plant results, certain furnaces are equipped so that either of the fuels can be used—gas when it is available—stored liquid fuel to make up any deficiency in gas.

In furnaces where burners are equipped to handle multiple fuels, the fuel-air ratio control sometimes presents a problem. Hagan engineers have developed two basic schemes for handling problems for this kind. One is suitable for furnaces which can handle both fuels simultaneously in any proportion. The other is designed for furnaces where either one or the other fuel must be used. In either case, furnace atmosphere is accurately maintained over extreme ranges of firing rate by use of simple, stable, powerful devices used in conjunction with the Hagan Spinning-type Pilot Valve. Your inquiry for complete details will have prompt attention.

Hagan Spinning Pilot Valve.

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

For Quick and Efficient Performance

FURNANCE FOUNDATION
CONSTRUCTION AT NIGHT

Designers
Builders
Engineers
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ERECTING FURNACE
STEELWORK
OCT. 31, 1942

OPEN HEARTH FURNACES

ERECTING FURNACES
JAN. 1, 1943

At Plant of
KAISER COMPANY, Inc.
IRON AND STEEL DIVISION
Fontana, California

TEEMING SIDE
OF FURNACES
MARCH 8, 1943

Furnace Construction by

INITIAL OPERATION
MAY 14, 1943

LOFTUS ENGINEERING *Corporation*

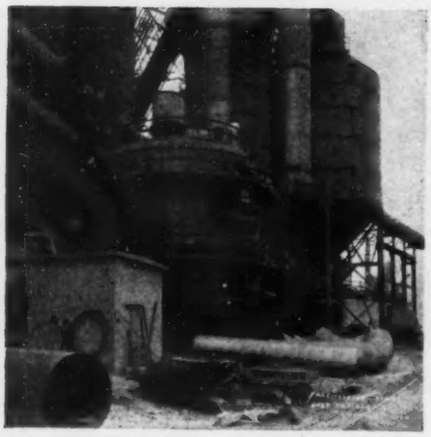
OLIVER BLDG. PITTSBURGH, PA.

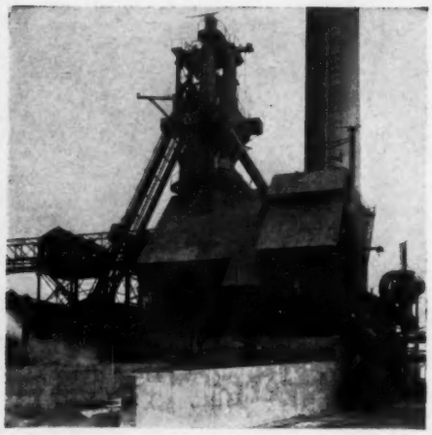
PENNSYLVANIA ENGINEERING WORKS

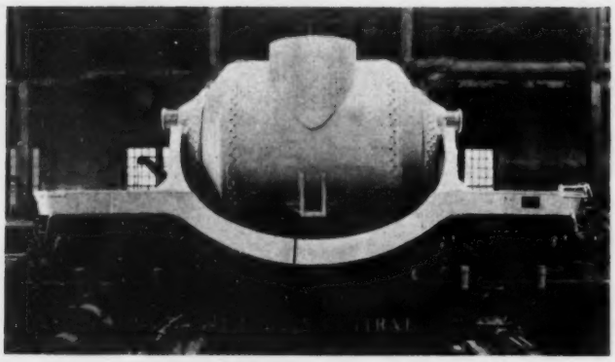
NEW CASTLE, PENNA.

Engineers - Contractors - Erectors

Builders of Blast Furnace and Blast Furnace Equipment

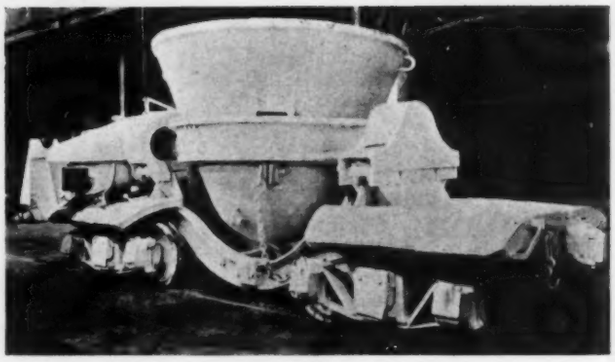






Heat Retaining Hot Metal Car

Bells
Hoppers
Furnace Shells
Bustle Pipes
Tuyere Jackets
Bosh Bands
Hot Blast Stoves
Stove Fittings
Hearth Jackets
Dust Catchers
Gas Washers
Skip Cars
Skip Inclines
Cast Houses
Ore Bins
Gas Mains
Blast Mains
Columns
Valves
Burners
Hot Metal Cars
Cinder Cars

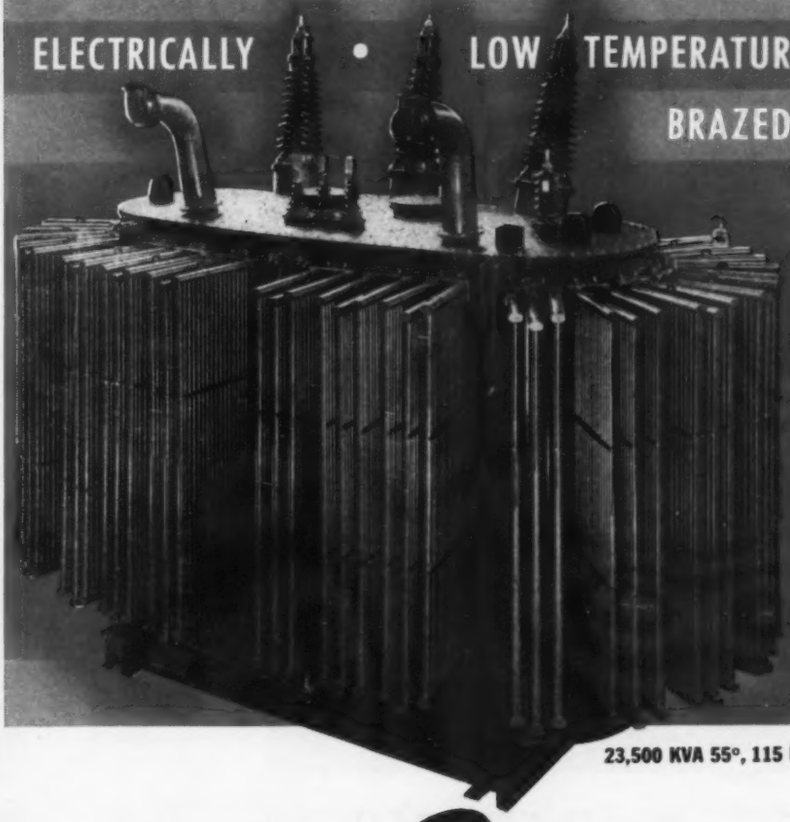


Blast Furnace Slag Car

Blast Furnaces Repaired, Dismantled, Enlarged, Modernized

Complete facilities within our own organization enable us to give prompt and efficient service. In addition to our engineering and erecting departments, our facilities include a machine shop, plate shop, structural shop, welding shop, forge shop and pattern shop.

CIRCULAR COILS, PRECOMPRESSED AND LOCKED IN PLACE, PREVENT MOVEMENT UNDER SHORT CIRCUIT STRESS • COILS RADIALLY AND AXIALLY BALANCED ELECTRICALLY • LOW TEMPERATURE VARNISH IMPREGNATION • BRAZED CONNECTIONS • STRAIGHT LINE TAP CHANGERS • HEAVY GAUGE RADIATORS • HIGH PRESSURE RADIATOR TESTING • FLEXIBLE EXPANSION TANK CONNECTORS • BASE CONSTRUCTION PERMITS 4-DIRECTION MOVEMENT • COVER, CORE AND COIL REMOVABLE AS A UNIT • ETC.



23,500 KVA 55°, 115 KV 3-phase

Pennsylvania Power Transformers incorporate all the factors for outstanding performance*

Feature by feature, Pennsylvania Power Transformers are equal to any and superior to many. But when you buy Power Transformers you are not buying individual features, specific gadgets or trimmings. You seek overall *performance** . . . resulting from a *combination* of *all* factors necessary to produce maximum *effective operation.*

This combination entails three prime requisites:—(1) sound, advanced engineering design, (2) top quality materials and (3) adequate plant facilities coupled with skilled craftsmanship. *Pennsylvania* has "all three."

Power Transformers are built to rigid specifications. *Pennsylvania's* ability to fulfill the most exacting requirements has been demonstrated by the successful manufacture of transformers as large as 30,000 KVA and 165,000 V; the largest air cooled Welding Transformers ever made; some of the largest Furnace Transformers in existence; and the development of transformers with underload tap changers.

Pick Pennsylvanias for performance.

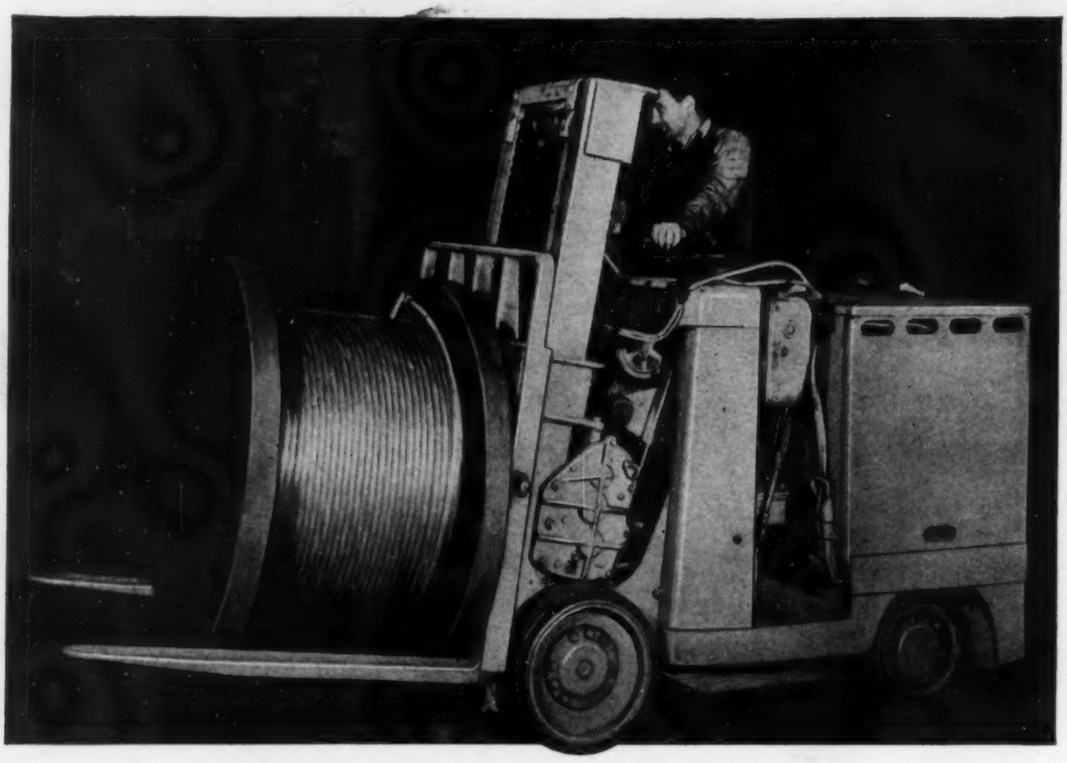
* **PERFORMANCE—the execution of the functions required; effective operation.**
—Webster

Pennsylvania Transformer Company

808 RIDGE AVENUE N. S. PITTSBURGH 12, PA.

Pennsylvania TRANSFORMERS

STOP AND GO

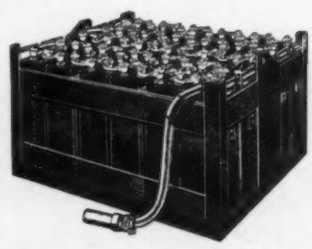


Modern, center-control fork trucks handle palletized unit loads; can also pick up and carry many types of loads without the use of any kind of dunnage. With batteries exchanged once or twice a day, they operate 24 hours a day with maximum dependability. Articles describing modern handling methods appear regularly in STORAGE BATTERY POWER. Write for sample copy if you do not already receive it.

In replacing a loaded skid box with an empty beside a machine, an industrial truck will make an average of approximately 14 moves forward, backward, up and down. A battery industrial truck has a natural advantage in this kind of stop-and-go service because it gets the necessary surges of power instantly from its battery, yet consumes no power during the stops. Thus it is not only economical of power, but the electricity used for charging its batteries is low-cost power.

Its electric-motor drive operates quietly, without vibration, and thus with well-nigh negligible repair requirements. With batteries exchanged two or three times per 24 hour day, it is continuously supplied with power and, since one battery is charged while the other works, the truck need not stop work for servicing of its power unit.

For 24 hour-a-day material-handling work, therefore, a battery industrial truck is an inherently dependable and economical machine, especially when powered by Edison Alkaline batteries. With steel cell construction, a solution that is a natural preservative of steel, and a foolproof electrochemical principle of operation, they are the longest-lived, most durable, and most trouble-free batteries. *Edison Storage Battery Division of Thomas A. Edison, Inc., West Orange, New Jersey.*



Edison
ALKALINE BATTERIES

THE BATTLE FOR FUEL

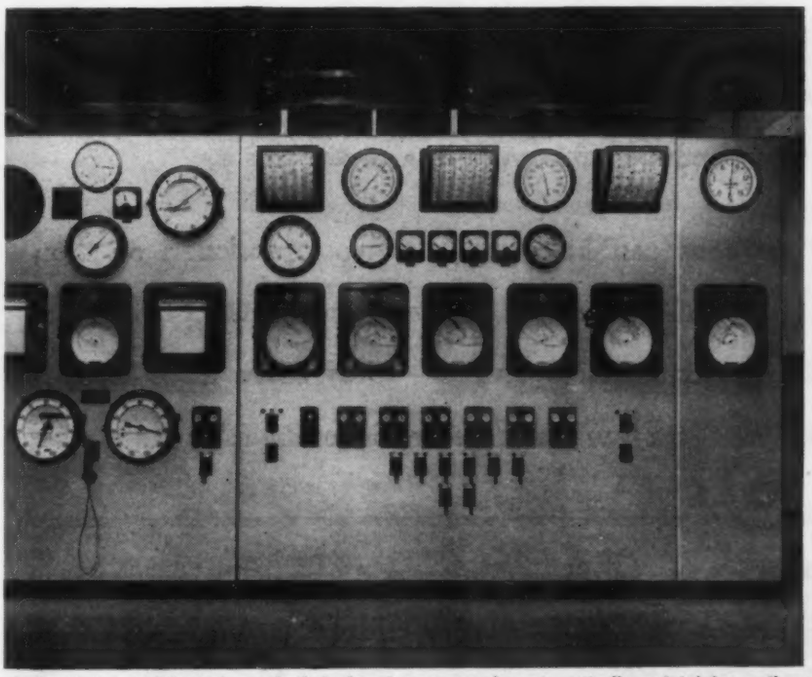
★ Early victory on the battlefield will not cancel the battle for fuel—it will be fought in fuel-burning plants everywhere this winter. In the case of coal, it is estimated that requirements will exceed production by 30 million tons. Since stock piles are at an all time low, rigid conservation must be practiced.

It is the duty of every Engineer who is responsible for the burning of fuel to cooperate with the National Fuel Efficiency Program. He should give careful attention to economy in both the generation and utilization of steam and heat. In this task Bailey Meters and Bailey Meter Control provide the means for—

1. Determining true combustion conditions.
2. Accurately measuring and recording heat units both at the point of generation and at the point of consumption.
3. Duplicating conditions which have been determined by test to result in the highest economy.
4. Continuously and automatically maintaining optimum conditions during routine operation.

How Bailey Equipment and Bailey Field Engineers help you to save both fuel and manpower is outlined in Bulletin 15-B. Write for your copy today. G-23-1

BAILEY METER COMPANY
1047 IVANHOE ROAD • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada



Bailey Meters and Control save both fuel and manpower by automatically maintaining optimum conditions in the generation and utilization of heat units.

BAILEY METER CONTROL

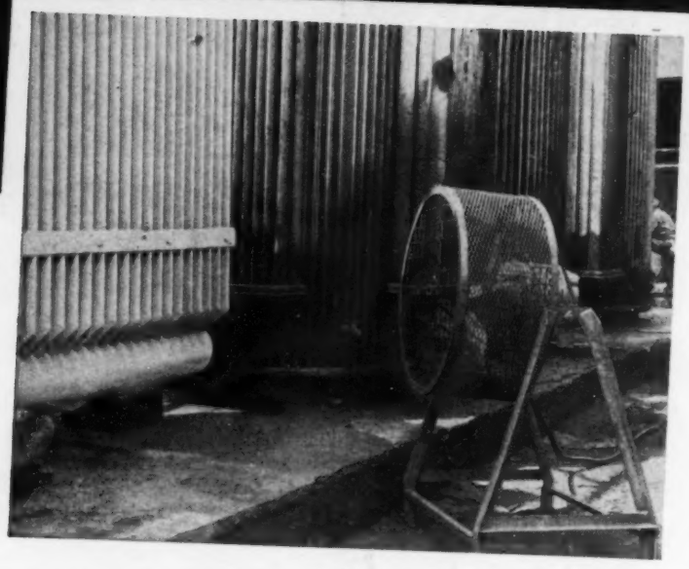
BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

The Complete Combustion Control System

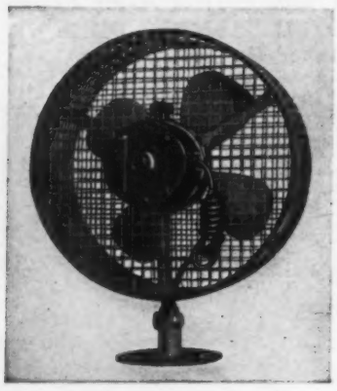
Let *Truflo Fans* . . .

Help keep your workmen on their toes

Portable Fan No. TF-100, recognized as standard in many of the country's largest mills. Sizes from 12 in. to 36 in. in diameter.



Portable Fan No. TF-300 in operation, cooling large transformers in strip mill.



Crane Cab Fan, for cooling crane cab interiors and other confined areas. Available in 12 in. and 18 in. sizes, adjustable both horizontally and vertically.

Portable Fan No. TF-300W. Angle iron support adjusts for vertical or horizontal discharge through almost 360°.

It's more important now than ever before to keep your workmen comfortable. For comfortable workmen are more efficient, produce more work in a given time.

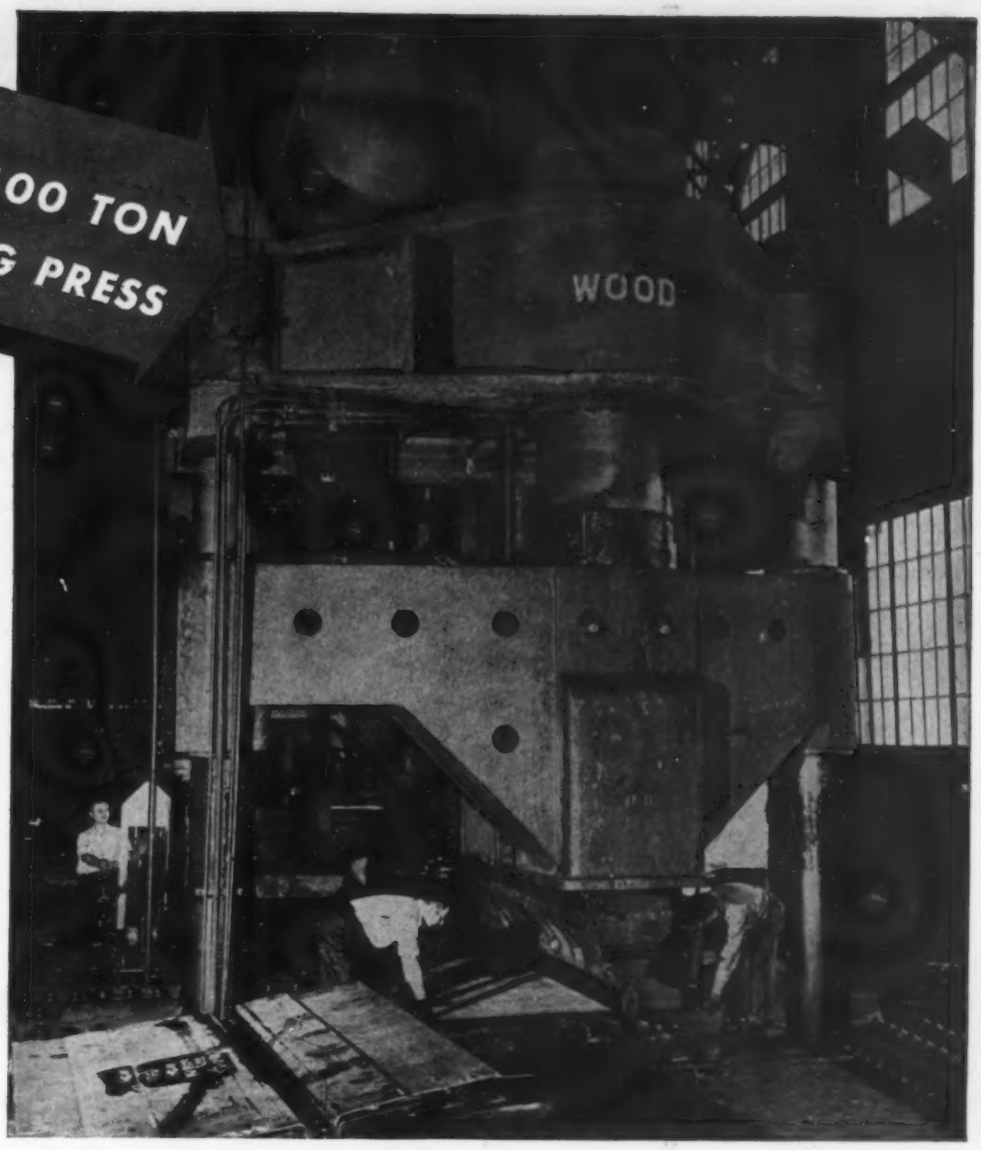
Truflo Fans can help you keep your workmen on their toes. All Truflo Fans are designed and built correctly for efficient, economical operation — they move more air per dollar. Write for free literature on any of the following styles:

Portable Cooling Fans • Crane Cab Fans
Wall Fans • Exhaust Fans • Blowers
Roof Ventilating Fans • Pent House Fans

TRUFLO FAN COMPANY

554 MAIN STREET HARMONY, PA.

A WOOD 1500 TON KEEL BENDING PRESS



Hydraulic presses have long been essential equipment throughout the Nation's busy shipyards. Wood presses are quickly and efficiently doing jobs of bending, forming, straightening, forging and pressing, etc.—helping to speed construction of America's bridge of ships.

The press shown here, a recent Wood development, has a record of such achievement. Standing approximately 30' high, this unit has two main rams of 48" stroke. The clear distance between columns, right-to-left, is 9' 10" and the front-to-back is 11' 10". The moving platen can be inclined, front-to-back, as much as 11½ degrees from the horizontal.

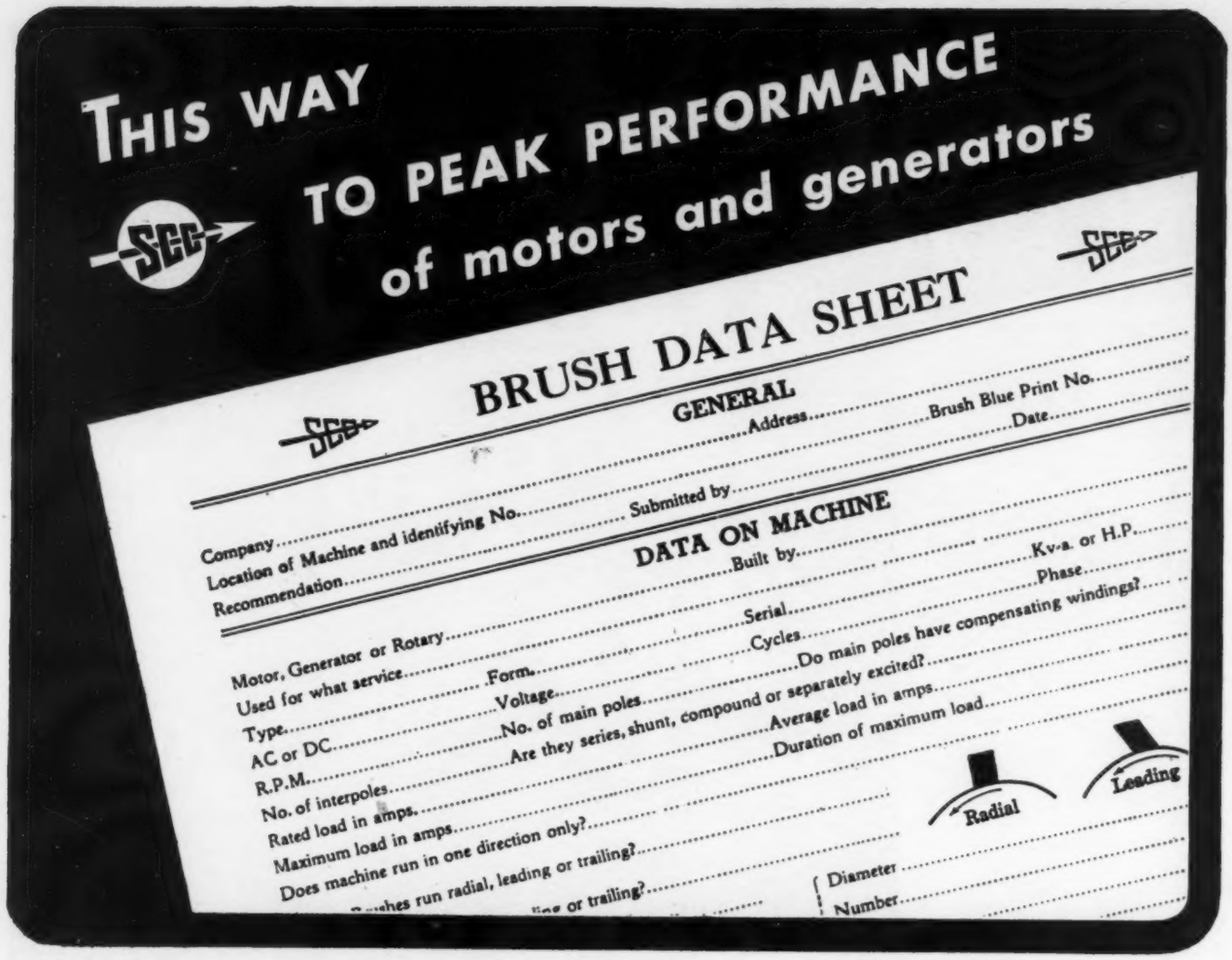
Consult R. D. Wood engineers on your hydraulic problems.

R. D. WOOD CO.

PHILADELPHIA 5, PENNA.

HYDRAULIC PRESSES AND VALVES FOR EVERY PURPOSE

THIS WAY TO PEAK PERFORMANCE of motors and generators



IT TAKES GOOD COMMUTATION to get peak performance from motors, generators and other rotating equipment which have current collecting parts . . . and good commutation calls for brushes that match the characteristics and service conditions of each machine.

Matching brushes to machines . . . helping to solve all kinds of commutation problems . . . have been SPEER specialties for nearly 50 years. So if you're having brush troubles on machines now in service or are interested in building peak performance into new commutating equipment, why not call on SPEER's long, diversified experience in brush application? Chances are it will simplify your problem . . . even save time and expense . . . as it has for many other brush users.

Three simple steps will bring you this SPEER service promptly and without obligation: 1 — Send for Brush Data Forms — one for each machine on which there's a problem; 2—Fill in and return the forms; 3—Our recommendation will then be submitted.

SPEER
CARBON COMPANY
ST. MARYS, PA.
CHICAGO · CLEVELAND · DETROIT
MILWAUKEE · NEW YORK · PITTSBURGH

Check Your Combustion Control with the

IMPROVED ISLEY COMBUSTION CONTROL SYSTEM

Designed and Built by MORGAN CONSTRUCTION COMPANY

PLAN *NOW* FOR THESE COMBUSTION CONTROL ADVANTAGES

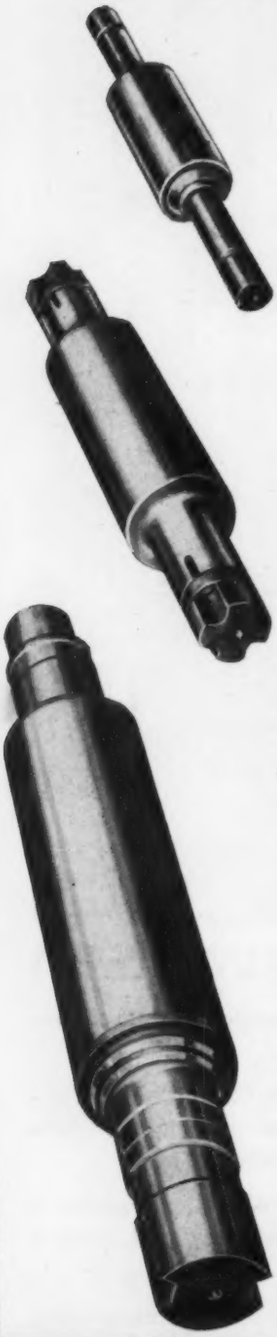
Your future needs may call for increased furnace capacity — and more all-around efficiency. Why not compare your present system with the following advantages of the Improved Isley Combustion Control System — and start planning with us for better future performances?

- ✓ **HIGHEST EFFICIENCY** . . . not affected by gas temperatures due to controlled operation by blowers.
- ✓ **NO LEAKS — LOW MAINTENANCE** . . . through improved "remote-controlled" gate valves, not exposed to hot gases or violent changes in temperature.
- ✓ **INCREASED REGENERATIVE CAPACITY** . . . due to strong push and pull action which permits use of extra regenerator chambers and higher temperature of combustion air.
- ✓ **NO VARIATION IN AIR SUPPLY DURING REVERSAL PERIOD** . . . again due to strong and constant push and pull action without time lag.
- ✓ **INCREASED FURNACE CAPACITY** . . . because of better and more efficient combustion, quick, positive reversal.
- ✓ **SAVING IN POWER** . . . because two fans are used, each of proper capacity for its function.
- ✓ **INSTALLATION ECONOMY** . . . requiring less steel, smaller foundations than demanded by the usual tall stacks and elaborate valve systems.

V-46

MORGAN CONSTRUCTION COMPANY, Worcester, Massachusetts

NATIONAL ROLLS



MEN MILLS, SHIPS AND MONEY

AMERICAN industry, particularly in basic products, will hereafter take definite place as the industrial headquarters of the world.

At war's end, we will have an undisturbed land, abundant natural resources, and the men, money and ships to accept full leadership in world reconstruction.

In the peace readjustment, easy access to foreign markets must be yielded, at least temporarily, as few of the nations involved will be able to serve their own markets without our materials.

Iron and steel will be among the chief materials needed, and to shape these metals, we produce the best implements we know how to make—NATIONAL ROLLS—and expect to do our part in the production of the shapes, sheets, plates and rods required.

With confidence in American industry, and particularly the steel industry, we look forward in faith to an active future.

★ The NATIONAL ROLL & FOUNDRY COMPANY ★

All Grades of Cast Rolls—Iron and Iron Alloy—Steel and Steel Alloy
Heavy Iron Castings and Rolling Mill Equipment

★ AVONMORE, PA. ★

Positive Pressure Lubrication Protects

Pressure application systems insure dependable lubrication that keeps machines in steady operation — provided you use the most efficient lubricant.

NON-FLUID OIL positively qualifies. It contains nothing to make residue, so cannot clog fittings and allow bearings to run dry.

Because it lasts longer, it reduces lubricant and application cost by requiring less frequent application. Positively neutral, NON-FLUID OIL is recommended by most makers of ball and roller bearings.

Used successfully in leading iron and steel mills. Send for instructive bulletins.

•

New York & New Jersey Lubricant Co.

Main Office: 292 Madison Ave., New York 17, N. Y.

WAREHOUSES:

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St. Louis, Mo. — Detroit, Mich.
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TRADE MARK REGISTERED
NON-FLUID OIL
IN U.S. PAT. OFFICE & FOREIGN COUNTRIES

Modern Steel Mill Lubricant

Better Lubrication at Less Cost per Month

DE LAVAL WORM GEARS *Reduce Motor Costs!*

Ten of twenty De Laval worm gear units operating doors of open hearth furnaces.

So well pleased is the user with the continued, reliable service given by these *DE LAVAL WORM GEARS* through all the years since they were installed in 1933, that he has twice specified and bought "DE LAVAL GEARS" for further extensions in new equipment now going in.

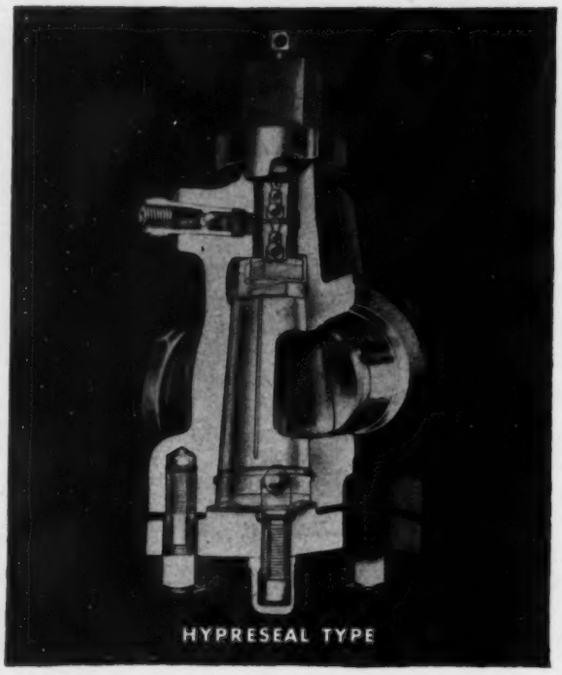
The wide range of speed reduction available with De Laval worm gears facilitates standardization of motor speeds and favors the selection of high-speed motors, which cost less, save power and improve power factor, as compared with slow-speed motors. Ask for Publication W-1136.

DE LAVAL WORM GEAR DIVISION

of the De Laval Steam Turbine Co., Trenton, N. J.

MANUFACTURERS OF TURBINES · STEAM HYDRAULIC PUMPS · CENTRIFUGAL PROPELLER ROTARY DISPLACEMENT · MOTOR-MOUNTED · MIXED FLOW · CLOGLESS · SELF-PRIMING CENTRIFUGAL BLOWERS and COMPRESSORS · GEARS · WORM, HELICAL and FLEXIBLE COUPLINGS

NORDSTROM
Lubricated Valves



Leak-resistant
Quarter turn to open
Floating plug
No exposed seat
Plug seated on lubricant film
"Sealdport lubrication
Corrosion-resistant
Erasion-resistant

Widely used in steel plants — on gas, chemical and oil lines — for positive control, regardless of pressure or temperature.

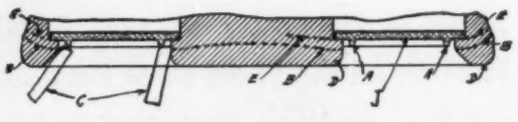
Keep Upkeep Down

MERCO NORDSTROM VALVE CO.
A Subsidiary of Pittsburgh Equitable Meter Co.
Main Office: 400 Lexington Avenue, Pittsburgh 8, Pa.
Branch in Principal Cities

Ohio Magnet Outer Rings Seldom Break

The bottom or wearing face of an Ohio Magnet presents a solid long lived surface to the work.

The annular rings on the manganese bottom plate prevent dangerous wear of steel pole shoes, so bottom plate cannot sag. **See cut below.**



Note wear line B B B

There are no holes or depressions to start wear or cracks.

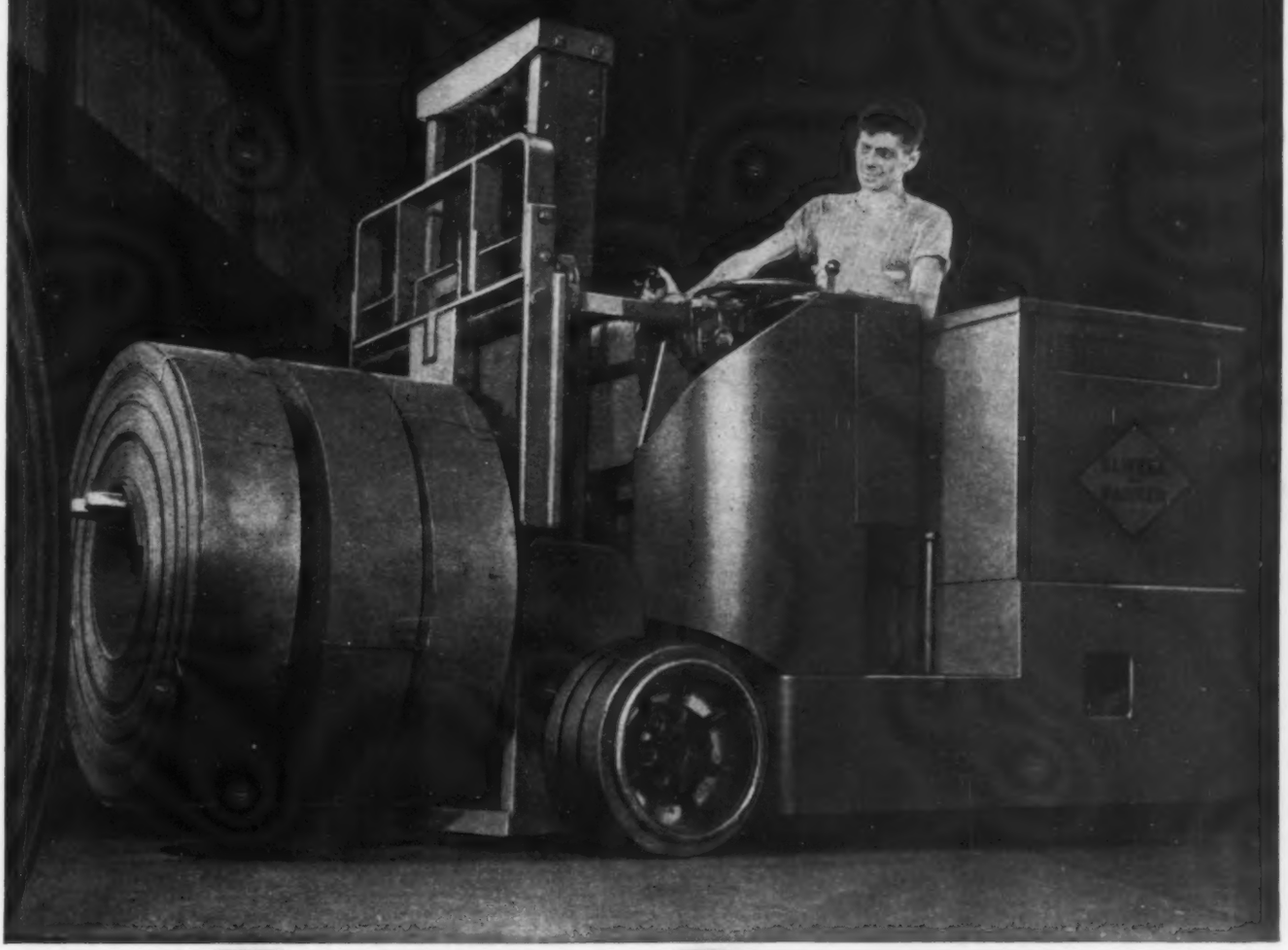
These features result in
LOW MAINTENANCE COST.

OHIO reliable MAGNETS

The OHIO Electric Mfg. Company
5907 Maurice Avenue
Cleveland 4 · · Ohio

HERE goes a big load of steel between hot mill and pickling line—it follows a route with so many turns that no other mechanical method would be practical • The Elwell-Parker Field Engineer in your District is trained and qualified to help with the planning of Truck and Crane Systems to simplify your transportation—to handle heavier loads faster, more safely —and to reduce your Mill costs. *Dial the E-P Man today.*

The Elwell-Parker Electric Company, 4504 St. Clair Avenue, Cleveland 14, Ohio.



ELWELL-PARKER

POWER INDUSTRIAL TRUCKS

Mr. Superintendent!

News Item for YOU

Variety of Stuff Taken From Sewer

"It's interesting work," says Bill Royal as a crew under his direction drags truck loads of cinders, chunks of solidified soda ash, old overalls, sticks and blocks of wood, pieces of pipe and dozens of other kinds of material out of the storm sewers serving the ——— roundhouse.

Royal, from Chicago, is a superintendent for the PITTSBURGH PIPE CLEANER COMPANY, a contracting firm working almost alone in its field in cleaning water mains, sewers, tubes, sprinkler system and fuel pipes for railroads, steel mills, refineries and other clients.

Three methods are used—electrical machines, hydraulic tools and mechanical dragging equipment. The latter system is assigned to the job now in progress here. A half-inch steel cable is fished through by linking short sections of wooden sewer rod. Gasoline-powered winches drag cleaning tools and pick-up buckets back and forth between manholes, restoring the pipe to its original inside diameter without disturbing the installation.

News item from a Creston, Iowa paper.

Name of railroad deleted.

Mill scale and dirt removed from 350' of 48" sewer in a steel plant by Pittsburgh Pipe Cleaner Co.

As a Postscript We Would Add:

1. WATER MAIN CLEANING SERVICE
6" to 60"

2. WATER PIPE CLEANING SERVICE
½" to 6"

3. TUBE CLEANING SERVICE;
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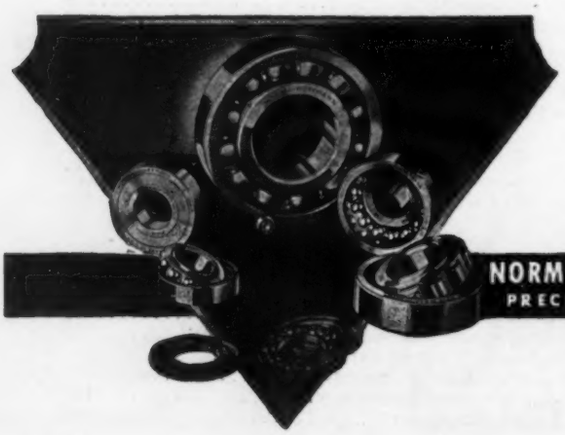

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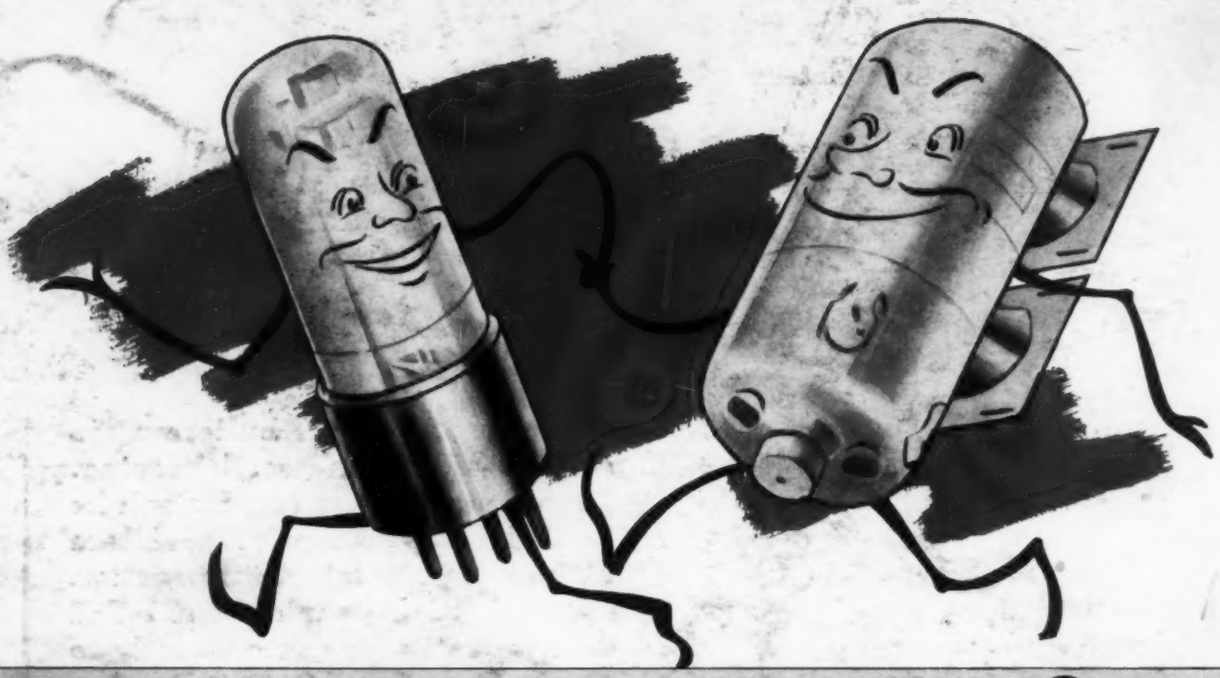
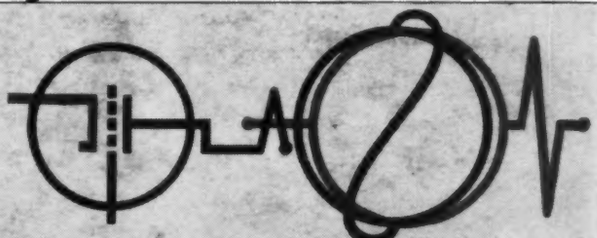


What will this pair do next?



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